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Welding Engineer

SEPTEMBER, 194

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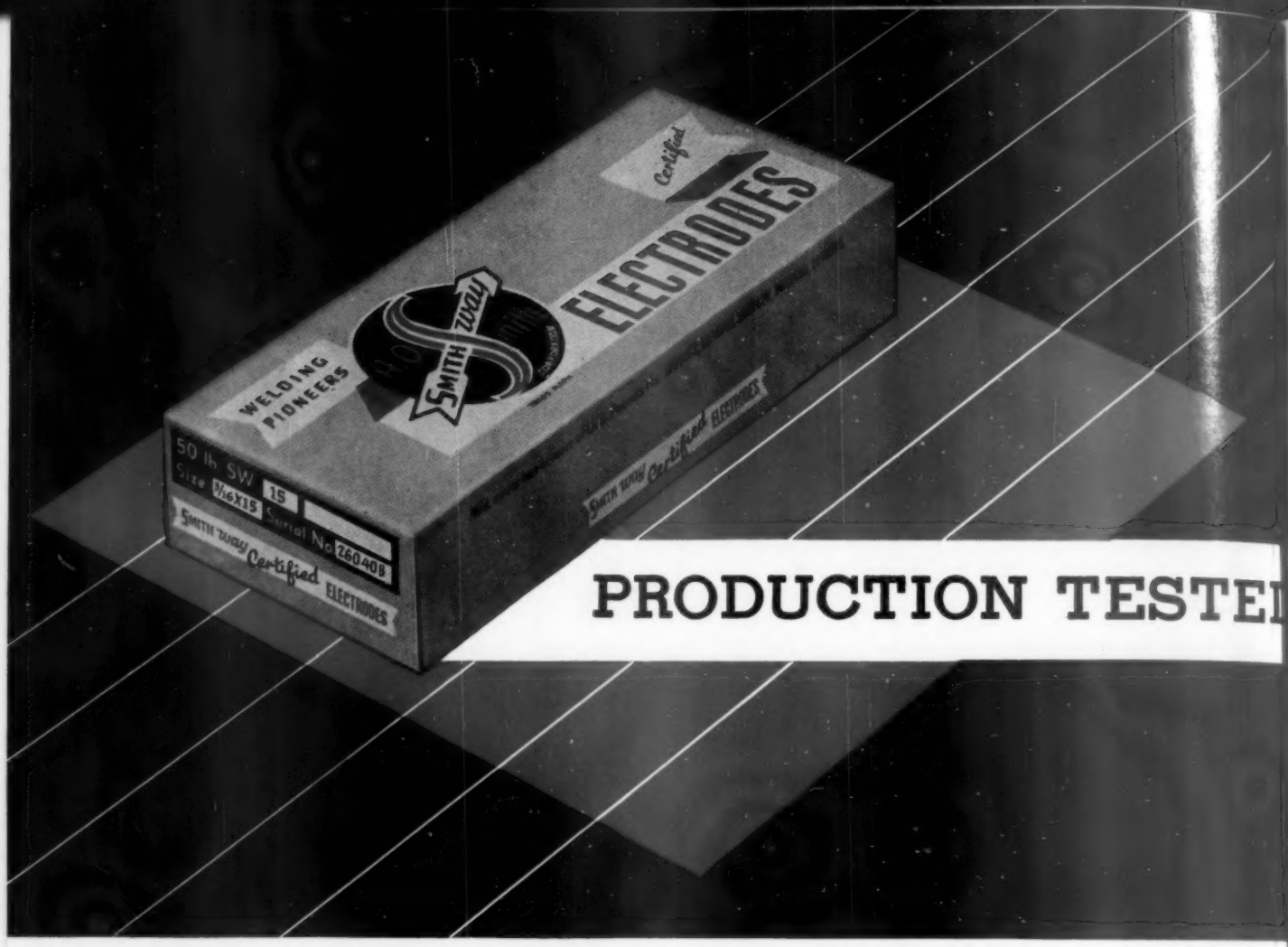

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The Welding Engineer

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The welded rings shown here are manufactured by the American Welding and Manufacturing Company, Warren, Ohio, from sections and bars of N-A-X Alloy Steel, produced by Great Lakes Steel Corporation.

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

Seven Per Cent . . .

Things seem to be going well on the war fronts as far as the Allies are concerned. Africa and now Sicily have been wholly won, Italy is nearly out of it, Berlin is being bombed with block busters, and each day records new gains in Russia and in the Pacific. Nevertheless, there is still a big job to be done, and the war is far from being won.

War Mobilization Director Byrnes recently pointed out that (in Africa and Sicily), "We have met and defeated less than seven per cent of the combat divisions which the enemy has in the European Area". Few of us realize that so little of the task before us has been completed. We simply don't grasp the implication of those figures. If we did, we would work harder, take fewer days off—and those only because of illness or other unavoidable necessity.

Jack, a weldor I know, is a case in point. Jack has reached the height of his ambition, apparently. (Unfortunately, this seems to be true of many other war workers.) His only interest as far as the job is concerned is his pay check, and there isn't too much interest in that, even. Maybe his interest lies in taking days off so that he may have time to spend the generous pay check he receives (even with days off) each week.

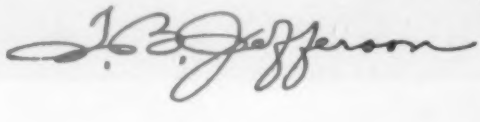
Jack could make $86.84 a week. Good money for a fellow of only 22 who only three years ago was quite happy at $18 a week in a filling station! There were a lot of hours required for that $18 a week—many more than the 48 hours that will now produce $86.84. Jack doesn't even work 48 hours—not even an eight-hour day for six days a week. In wartime and with present labor shortages!

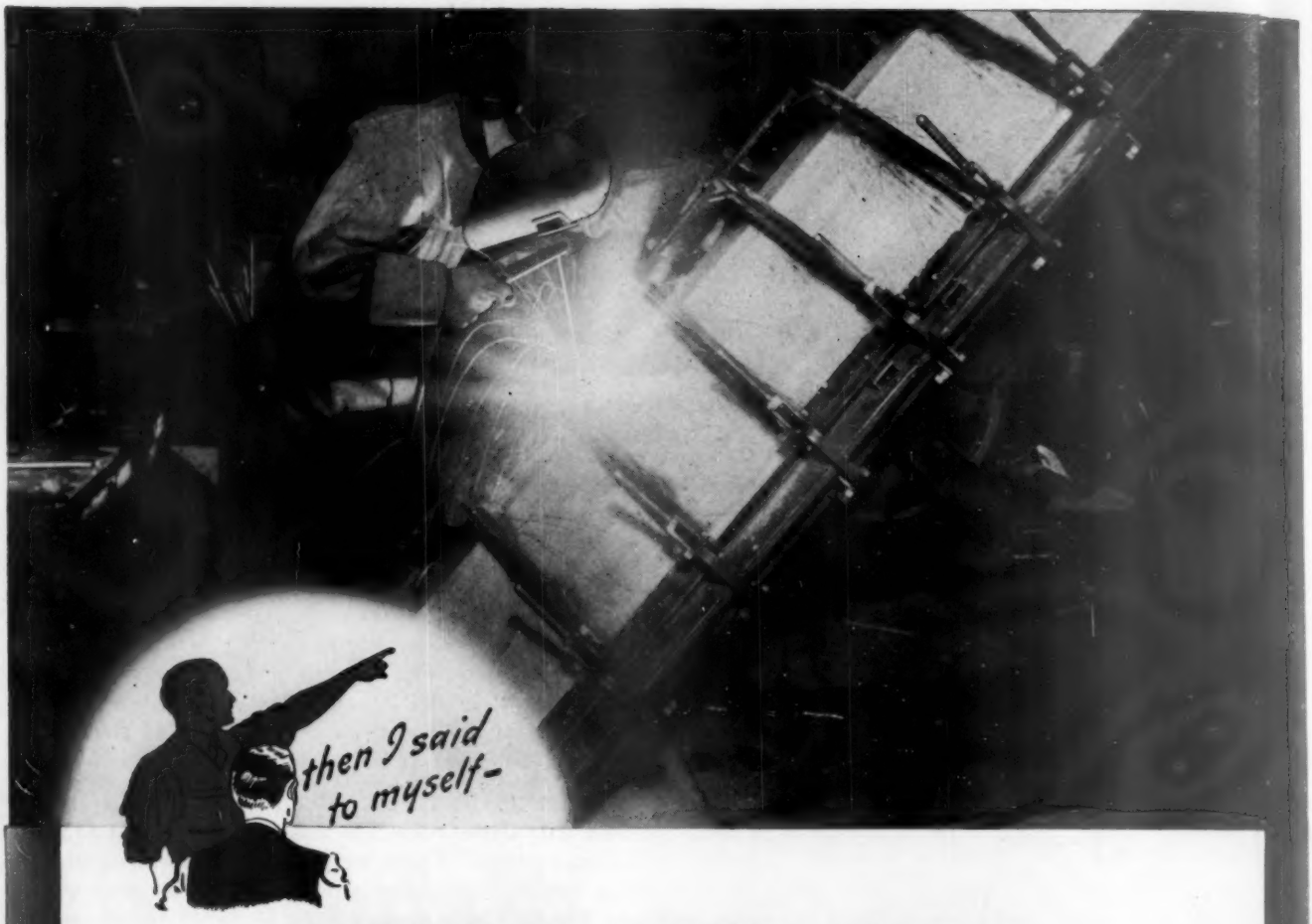
This isn't all of the story, either. Yes, for a youth of his age Jack is doing well, earning good money, but he isn't getting anywhere. He isn't learning anything new because his interest stopped short after he had learned welding at a trade school. Now he does nothing but downhand production welding. He has been on this one job so long, and has had so little experience in other welding positions, it is doubtful if he could even be called a weldor. At least he won't be one when we have finished the other 93% of the enemy's combat divisions. He'll be looking for a job then—and lucky to find one at his former pay of $18 per.

Even though our task is only seven per cent done, it is none too early for us to start preparing for the days which will follow the coming of peace. An ideal way to start would be by getting interested in the job at hand, whatever it may be and endeavoring to better ourselves so as to be better suited to cope with the jobs ahead.

The soldier on the battle front is putting forth his utmost effort to win. The War Production worker on the home front should be striving equally as hard. Staying on the job and doing an honest day's work is one way to shorten the war. More *effective* man-hours will mean that the home front will be able to send more implements of war to the fighting front.

If staying on the job will mean that we will be able to return sooner to a normal way of life, it should be well worth the sacrifice.





SPARE THE ROD
and
SPOIL THE SPEED

What IS the difference between a hit and a near miss?

Easy! This 1/8″ steel gear cover for a 5-inch gun mount offers an understandable answer. They made it with 1/8″ "Fleetweld" rods and 90 amps. THAT WAS A NEAR-MISS.

Why?

Because they changed to 3/16″ "Fleetweld" rods and 180 amps. and increased output 66%, cut the cost 20%. THAT WAS A HIT!

There are plenty of other ways in welding to push near-misses into the hit class . . . tilting, better fit-up, "Fleet-Fillet" Technique, beveling butt joints, etc. . . .

It might not be amiss to get the details.

THE LINCOLN ELECTRIC COMPANY OF CLEVELAND, OHIO

Hard[illegible]ions

★ Part One—By restoring worn automotive parts to new or better condition, hard-facing is helping to prevent breakdowns in our overburdened transportation system. Herein is told what equipment is needed, what rods to choose from and what parts are suited to hard-facing.

HARD-FACING is the process of overlaying by welding a hard, wear-resistant alloy on the surface of a softer base metal normally subjected to wear. The deposited alloy can be in the form of a coating, edge or point, depending on the size and shape of the wearing surface. Because of the nature of the process, the methods and equipment are, for the most part, similar to those employed in good welding practice.

Hard-Facing Adds to Life

The advantages of hard-facing are derived from the greater resistance to wear afforded by the hard alloy surface. Greater resistance to wear means longer life of parts, which reduces the need for frequent replacements. Additional advantages come from using hard-facing in salvaging worn parts, for worn parts can frequently be salvaged at low cost and made better than when they were new.

The oxy-acetylene welding flame, the metal arc or the carbon arc can be used to apply the standard hard-facing rods. The arc welding processes are at present widely used for coating large areas where surface finish is of little or no importance. For automobile and truck parts, they are usually less suitable than the oxy-acetylene process, since the flame provides better control over the molten puddle and results in less loss of alloy.

Before doing hard-facing work, it is desirable to determine if the base material is sound. This can be done by magnetic-particle methods.† Frequently, it is also advisable to check the hard-faced parts after the work is completed to make sure that no defects have been introduced by the hard-facing process.

The Oxy-Acetylene Process

The equipment required for hard-facing by the oxy-acetylene process comprises standard welding supplies, including sources of oxygen and acetylene, pressure regulators, hose and a suitable welding torch. Also needed are safety auxiliaries such as gloves and goggles, a fireproof welding table and a good water supply, hard-facing rods and fluxes and (particularly if large numbers of similar parts are to be hard-faced) suitable jigs or fixtures. Facilities for preheating are also desirable if large parts are to be hard-faced or if the parts to be hard-faced are of carbon or alloy steels containing over 0.50% carbon. Preheating equipment may range from homemade gas-fired brick furnaces to complex commercial heating furnaces equipped with precision temperature controls. For the slow cooling of hard-faced parts, a large box containing lime or powdered mica is often useful.

Arc Welding Technique

The heat in the arc welding process is much higher but covers only about one-tenth the area covered by the acetylene process. No preheating from the arc occurs when ordinary welding technique is employed. To preheat as in the acetylene process, the weldor must hold a long arc about ¼ inch in length. Voltage and amperage settings for arc welded hard-facing applications are quite similar to those required for mild steel electrodes.

A circular motion about ¾ to 1 in. in diameter should be used. To start the circular motion, strike the arc in what will be the center of the circle. Move slowly to the outer edge and continue the circle. The second and succeeding circles should advance ¼ inch to the cycle. The idea is to keep the deposited hard-facing metal fluid long enough to raise all the impurities and oxides on the surface of the steel to the surface of the molten hard metal and allow it to solidify in a smooth, solid deposit. This postheating on each cycle is the only way it can be done correctly.

If the weldor advances more than ¼ inch to the cycle or moves too fast,

---

* Prepared for Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation.

† See "Magnetic Inspection of Welds," THE WELDING ENGINEER, August, 1943.

Courtesy, Stoody Co.

Hard-facing a worn exhaust valve with a Class III (cobalt base) alloy.

slag from the coating on the rod drops on the colder surface of the steel and solidifies. The hard metal will flow around it and leave a slag hole. To raise this slag, the arc must be held over it until it melts and flows back on the hard metal. It is necessary to go back over the previously deposited metal and come back out over the edge of the molten metal onto the steel surface. If the speed of the cycle is too great, the same condition results. The speed of the cycle is determined by the melting of the steel surface. The fluid hard-facing will flow into the surface of the steel as fast as it reaches the melting point. If the machine setting is correct and the proper length of arc is used, the cycle will require about three seconds.

Hard-Facing Rods

Hard-facing rods fall into five major classes as follows:

Class I. Alloy cast irons and steels containing less than 20% alloying constituents.

Class II. Iron-base alloys containing over 20% alloying constituents (such as chromium, tungsten, molybdenum, manganese, vanadium).

Class III. Non-ferrous materials, such as cobalt-base alloys containing chromium and tungsten.

Class IV. Cast tungsten carbide which has been crushed and is contained or embedded in a high-strength steel binder.

Class V. Diamond substitutes consisting of small (usually ⅜ to 1½ in. long) cast "inserts" of tungsten carbide.

In terms of resistance to wear where there is no accompanying impact or shock, the protection afforded by these classes of alloys ranges from Class I, with the least resistance, to Class V, with the greatest. This order is, in general, also that of their cost per pound, which ranges from approximately 50 cents to $5.** The order is reversed if impact must be resisted, alloys of Class I being tougher than those of Class V. For surfaces where smoothness or precision tolerances are not required, the choice of alloy is determined by a balance of the factors of wear resistance, impact resistance and cost. If a smooth or precision surface is necessary, only alloys in Classes I, II and III can be considered. Since most automotive uses require a smooth hard-faced part, the most wear-resistant of the first three classes would normally be chosen.

The welding rod manufacturer should be consulted on the proper rod to use and the proper method of application for any job in hand.

Operator Training

Any experienced weldor can, with a little practice, produce hard-faced parts that are excellent in qualities of bond, surface smoothness and freedom from impurities or blowholes.

To apply the alloys of Classes II and III, only a few variations of standard steel welding procedures are necessary. The following variations are given as examples of the modifications hard-facing may require:

Whenever possible, Class II and III alloys are applied on steel *without penetration* into the base metal; this is very important as it makes it possible to avoid dilution of the alloy with iron and thus to preserve unimpaired the abrasion-resisting qualities of the alloy. The operation is carried out with an oxy-acetylene flame containing an excess of acetylene and adjusted so that the flare or outer cone of the flame extends two or three times the length of the inner cone. With this flame, a small area of the surface to be hard-faced is brought to a sweating temperature; the end of the rod is brought into the flame, allowed to melt and spread evenly over the sweating area. The rod is not stirred or puddled; instead, additional alloy is spread in the desired direction on the base metal by means of the flame at the surface-sweating temperature.

Usually the deposit can be built up to the required thickness in one operation, and this is most desirable.

** See Engineering Data Sheet No. 16, "How Far Will a Pound Go," THE WELDING ENGINEER, January, 1942.

Three exhaust valves for a 600 hp marine motor. Left: new valve hard-faced with Class III alloy; center: an ordinary valve after 150 hr service; right: a hard-faced valve (Class III alloy) after 650 hr service.

Courtesy, Haynes Stellite Co.

The operator may need some special training or experience to do general hard-facing successfully, as is illustrated by the following examples.

In a certain shop, there were four weldors hard-facing the same kind of parts. The thickness of the hard-facing was ¼ in. Checked, these parts, were found to vary by as much as 10 points in hardness on the Rockwell C scale, and the iron dilution ran as high as 20%. Using the same make of hard-facing rod with the proper hard-facing technique resulted in only 3% to 4% iron dilution and only two points variation on the Rockwell C scale. Moreover, the wearing life of the parts was increased from an average of 140 hr to 300 hr.

Parts Regularly Hard-Faced

Representative automotive parts which are hard-faced by fleet owners or by job welding shops for the owners are: clutch parts, including release yokes, pressure plates, throw-out fingers and release-bearing housings; tappets, valve stems, stem ends and rocker arms; transmission-shifting fingers; and both water and fuel-pump shafts. Diesel engines often have several valve and injector parts which are hard-faced when manufactured.

Exhaust valves and exhaust-valve seat inserts are hard-faced in large numbers by valve manufacturers for the engines of buses, trucks and other commercial vehicles. The hard-facing of valves and valve seat inserts is rarely done except by valve manufacturers because of the necessity for specialized technique and finishing equipment and because of the need for close heat control to maintain the necessary properties and condition of the steel from which valves and inserts are made.

Clutch Mechanisms

Among the parts readily hard-faced in fleet maintenance shops are the wearing surfaces of clutch mechanisms. Clutch throw-out yokes are hard-faced by the application of a 1/16 in. layer of alloy to the ends of the yoke fingers. The smooth surface of the alloy has a low coefficient of friction and results in less wear on the clutch wheel surfaces.

Hard-facing the valve seat of a truck engine. In this application, it is important to use a hard-facing material capable of withstanding high heat.

Clutch plates are hard-faced with suitable grades of Class II or III alloy rods at three spots, each about ¾ in. in diameter, where the clutch-adjusting studs bear on the moving plate. Other wearing parts in the clutch are hard-faced just on those areas which otherwise wear at such rates as require frequent adjustment or replacement.

Valve tappets, stems and stem ends, as well as rocker arms, are frequently hard-faced to minimize wear. These applications follow the general procedure and can be made by any experienced operator. It is suggested, however, with regard to valve-seating surfaces that, if available, the valves and inserts be purchased hard-faced by their manufacturers because of the equipment and experience necessary to produce a thoroughly satisfactory product. Shops having such equipment and expert personnel are nevertheless turning out good and satisfactory work.

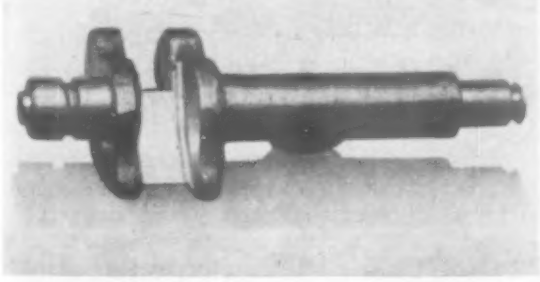
Pump Shafts

Water-pump shafts are faced over the bearing surfaces, particularly if the pump is packed. The application is most frequently made by the "skip" method, wherein longitudinal beads of a suitable grade of Class II or III alloy rod are applied first on one side of the shaft, then on the other, to minimize warpage caused by the heat of the welding flame. Shafts can sometimes be hard-faced successfully by the "spiral" method, wherein the bead is applied in the form of a helix. This can also be accomplished with little warpage from the heat of the flame. Not only do shafts hard-faced by either method last up to four times as long as steel shafts, but the need for tightening or replacing the packing is minimized because the smoothness and low coefficient of friction and freedom from rust or corrosion of Class II and III alloys will result in considerably reduced wear of the packing.

Trailer pintle hooks and eyes, tire chains, fifth-wheel pins, chain sprockets, brake cam shafts, etc. are also repaired by hard-facing.

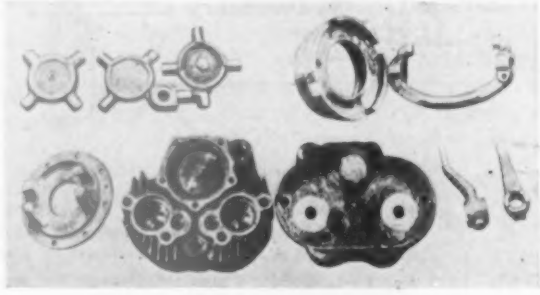
Many parts of machines used for automotive maintenance are protected from wear by hard-facing. Typical are: cams, lugs and wearing surfaces of automatic machinery; lathe and grinder centers; boring-bar wear strips; hot-flash shaving tools; dies of many types for hot-drawing, blanking, shearing, trimming, forming and upsetting. Dies for hot-working, it should be added, are generally hard-faced with a suitable grade of Class III alloy rod. To assure best results with complex dies or other intricate parts which may require special care, additional recommendations can be obtained from manufacturers of hard-facing alloys.

Part II, Instructions for Specific Hard-Facing Applications, will appear in an early issue of THE WELDING ENGINEER.



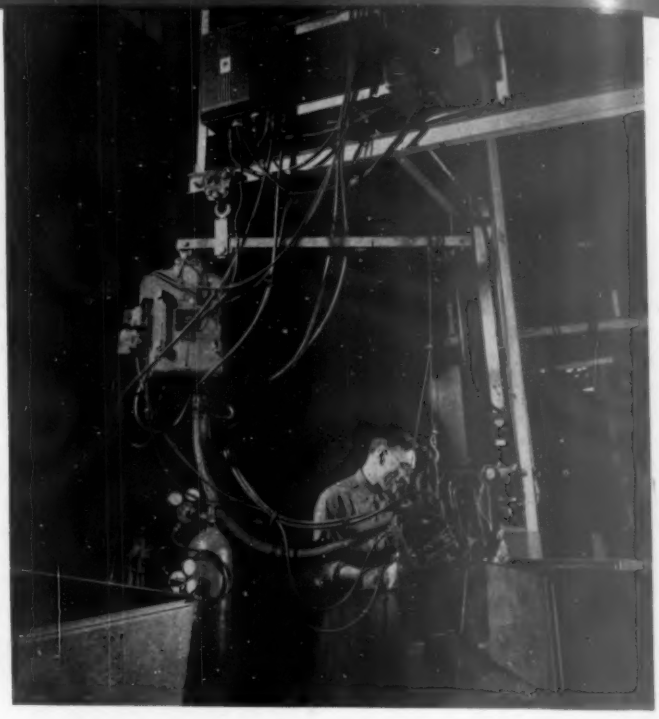
Left: Hard-faced fuel-pump cam rocker from a Diesel engine.

Right: Some typical automotive parts that have been successfully hard-faced.



Spot Welding Variables

By **L. D. JENNINGS**
Westinghouse Elec. & Mfg. Co.



A portable spot welding gun in operation. About 22 welds are made per minute, and each weld requires a current of about 350 amp.

IN RESISTANCE welding, metals are united by forcing them together by pressure and passing an electric current through a local area until a welding temperature has been reached. The welding temperature is dependent upon the material being joined. All non-ferrous alloys require melting-point temperatures, but ferrous alloys can be welded at a temperature below their melting points because of their wide plastic ranges. In the plastic state, the growing grains of one ferrous alloy piece will combine with the grain structure of the adjacent part to form a homogeneous alloy.

The Welding Transformer

To obtain a resistance weld, it is necessary to have a machine that will pass a high current through a local area of the metals to be joined for an accurately measured unit of time while pressure is applied at the heated area. The high current is obtained from a specially designed transformer that will step-down voltage from the customary line values to 4 to 12 volts. The schematic diagram of a resistance welding machine, Fig. 1, shows the transformer, which consists of a primary and secondary winding about a common core. Leads are taken from the secondary winding to two electrodes that can be closed by pressure upon the work. A stepped-up current flows from the transformer secondary to the electrodes and through the work. The resistance of the material, B, and the contact resistance between the work causes the generation of heat, which brings a local area to welding temperature and thus unites the metals at this point.

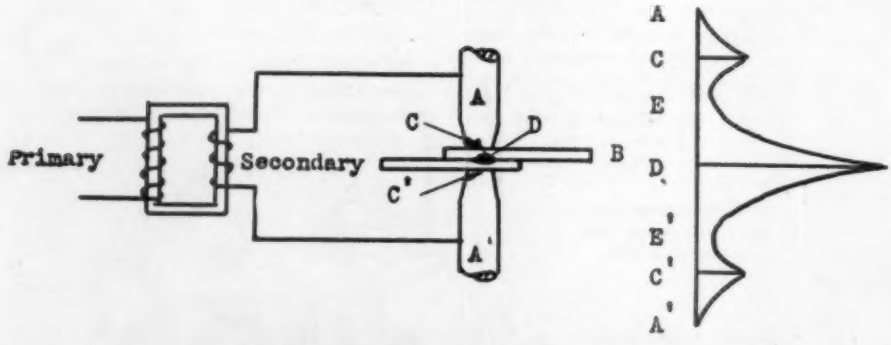


Fig. 1 (left)—Schematic diagram of resistance welding process. Leads are taken from the secondary winding of the transformer to two electrodes, A and A', which can be closed by pressure upon the work, B. Fig. 2—Temperature gradient through the work at point of welding.

Temperature Peaks

The temperature gradient through the work at the point of welding will show three peaks of high temperature —D, C and C′ in Fig. 2. The peak D is a point between the work at the area to be welded, and E and E′ are points within the work material nearer to the surface of the work adjacent to the electrodes. C and C′ represent the temperatures between the work surface and the electrode, and A and A′ are the temperatures of the electrodes a short distance from the electrode face. The theoretical ideal condition would be attained when peak D approached infinity while peaks C and C′ approached zero. This condition is not easily obtained, however, and is probably not greatly desirable. Should the contact resistance be equal at D, C and C′— as when welding copper with copper electrodes—a weld may be made at any or all of these points.

The contact resistance between the work sheets themselves and between the electrodes and the work is responsible for the high peak temperatures. Contact resistance depends upon:

Spot welding is not an exact science: mathematical formulae to cover all contingencies haven't been developed because of the large number of variables involved. Even without benefit of mathematics, though, amazing progress is being made today towards ever more accurate results.

A variety of odd-shaped pieces can be spot welded in this set-up. Door to control has been opened to show a portion of the interior.

(1) The surface condition of the work to be welded; *i. e.*, whether the surface is smooth, rough, scaly, dirty, etc. A smooth, clean surface has a lower contact resistance than a rough, scaly or dirty one.

(2) The specific electrical resistance of the material being welded (see Table II).

(3) Electrode variables, including size, shape, surface condition and electrode material.

(4) The amount of pressure forcing the electrodes together. The greater the closing pressure, the less the contact resistance (Fig. 3).

Spot Welding Machines

Resistance welding machines may be classed (depending upon the work they are to perform) as spot, seam, butt and flash welders. The spot welder is designed to join two or more lapped sheets of material at a spot by passing a high current through two pointed electrodes as they exert pressure upon the sheets. Since this type of machine is by far the most widely used, this article will henceforth be confined to spot welding.

When selecting a welding machine, the first thing to determine is whether it is to be used for an individual task or is to be adaptable for job-shop production. The answer to this question will dictate the transformer rating, the arm length and spacing, the type of electrodes, the pressure-closing device and the method of current timing.

The transformer must have sufficient capacity to accomplish the work. If a variety of tasks are to be performed, the transformer should either be supplied with taps and a convenient means of tap changing or be equipped with electric heat control.

The arms of the spot welder must have sufficient length and spacing; they must be adjustable and be capable of withdrawing the necessary pressures.

The pressure-applying device should be positive and easily adjusted. The cam-type or spring-type is recommended for small machines and light work, but an air- or hydraulic-operated press-type machine is essential for heavy spot and projection welding. The air- or hydraulic-operated device has a wider range of pressure adjustments and is also more easily regulated and controlled.

The timing may be manual, mechanical or electrical. Manual timing, dependent upon the operator's skill, will produce fair results when welding mild steel to mild steel. For non-ferrous alloys, however, and for production requirements demanding rapid, high-quality welding, the manual timer must give way to the more accurate mechanical and electronic timers. Such timers have had an important role in advancing resistance welding.

The electronic timer, in particular, is rapidly becoming the favored method of control.* The welding time may be adjusted from 1 to 30 cycles and the power varied from maximum to 40% by merely turning a "heat control" dial. With this device, an equivalent heat input is attained in each weld, as the flow of current is accurately measured in cycles and always begins at the zero point of the wave.

Spot Weld Testing

It is difficult to determine the strength of a spot weld because of the many variables involved in the process. Appearance of the sheet at the point of the weld is no clue to weld strength, nor is a shower of sparks from between the sheets. The latter, in fact, usually results in a cavity at the center of the weld, thus decreasing the size and strength of the spot. The most reliable method is a destructive test of the welded product, but this, of necessity, must be confined to test specimens. Test specimens that are welded in the same manner as the work being performed will, in general, give comparable results.

Many manufacturers supply test sheets of material identical to that being welded and require weld specimens to be made prior to starting each job and also at prescribed intervals throughout the run. The specimens are made by lapping sheets and welding at two spots approximately 2 in. apart. The test consists of forcing a

* See "Types of Electronic Controls" by T. R. Lawson, THE WELDING ENGINEER, February, 1943.

cold chisel between the spots and observing the difficulty of destroying the welds and whether the weld breaks near the welded surface or pulls a "button" from the sheet. If the work is made of magnetic materials and a large portion of it extends between the arms of the welder, a small test specimen will give a false comparison for reasons which will be later explained.

The strength of a weld may be accurately determined by tensile or "pull-test" specimens. It will be found that the first spot will be stronger than a second or third adjacent spot if the intervening space is such that a portion of the current will shunt through the first spot, so discretion must be used in selecting the spot for the tensile test.

Radiographic Inspection

The X-ray machine or radium provides a non-destructive method by which the cross-section and homogeneity of the weld may be determined. Strengths can be judged by comparing the radiographs with those of similar welds for which physical tests were made. Unfortunately, the radiographic method is not used as much as it should be because of the lack of equipment in many plants.

Pressure, Current, Voltage

Prior to being used in production, each resistance welder should be calibrated in order that the operator can intelligently adjust the machine settings to compensate for electrical variations. The operator should know the pressure exerted by the electrodes upon the work and the approximate current output of each tap of the welding transformer. The pressure can be easily measured with a gauge in the air line (if the machine is air-operated) or by closing the electrodes upon a specially designed diaphragm whose deflection is recorded on a pressure gauge.

Current output depends not only upon the turn ratio of the transformer and the heat tap upon which the welder is operating but upon the stability of the power supply, the arm spacing and the arm length.

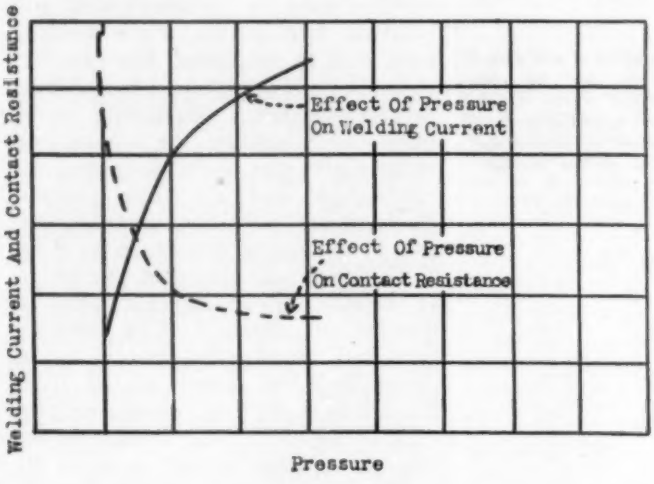

Welding Current And Contact Resistance
Effect Of Pressure On Welding Current
Effect Of Pressure On Contact Resistance
Pressure

Fig. 3 (left)—The effect of pressure upon contact resistance and current.

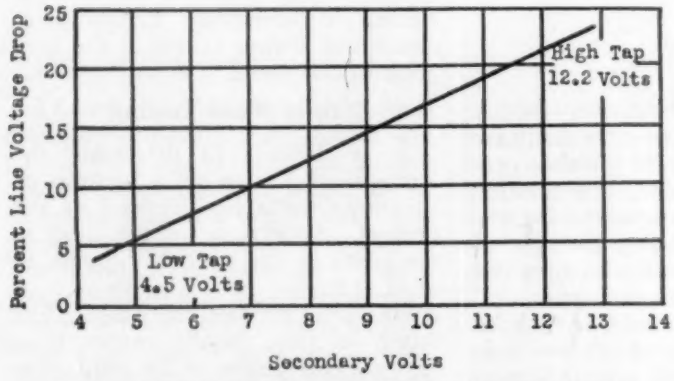


Fig. 4—The line-voltage drop varies directly as the current output.

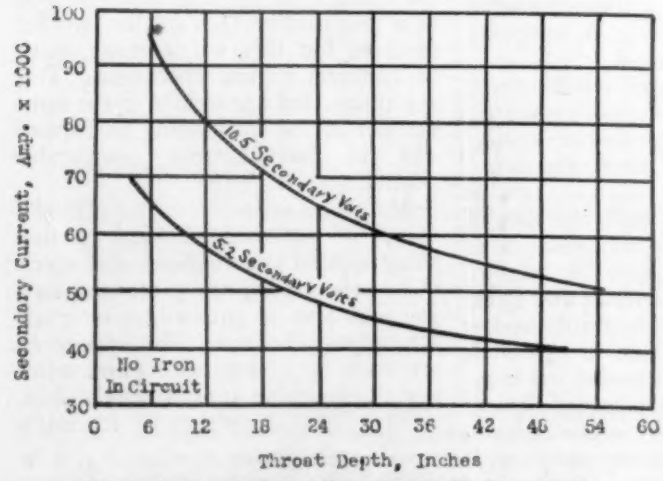


Fig. 5—Variations of secondary current with throat depth.

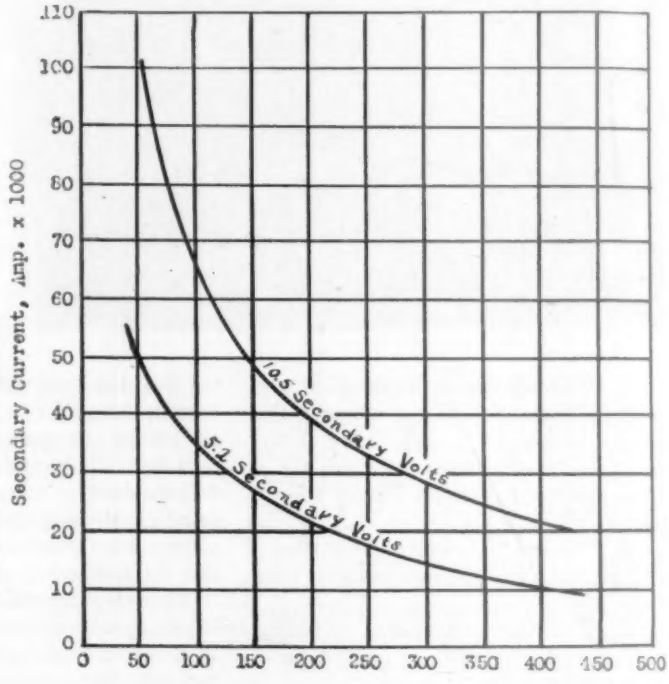


Fig. 6—Secondary current is reduced as the arm spacing is increased.

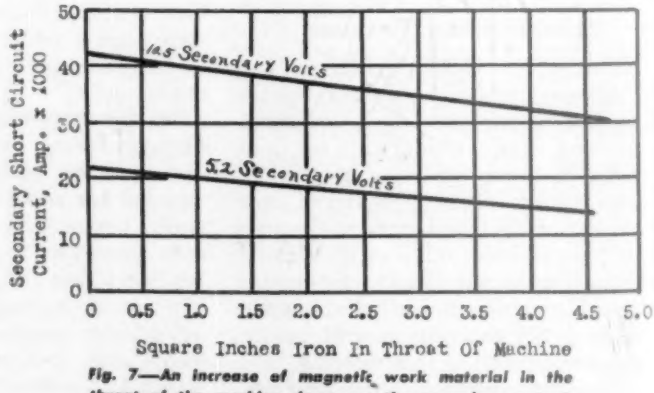

Secondary Short Circuit Current, Amp. x 1000
18.5 Secondary Volts
5.2 Secondary Volts
Square Inches Iron In Throat Of Machine

Fig. 7—An increase of magnetic work material in the throat of the machine decreases the secondary output.

Since the welding machine draws large currents for short intervals, dangerous line voltage drops will result if the equipment is not properly installed. Welders of 25 kva capacity and larger should be installed adjacent to a step-down power transformer whose primary is connected to a high voltage supply. It is common to experience voltage drops as high as 20% in the supply line. This is objectionable for satisfactory welding operation. Fig. 4 shows a voltage drop ranging from 4.5 to 21% for a 200 kva spot welder. The primary is supplied 230 volts from a 2,300 v transformer through 150 ft of 500,000 cir mils cable.

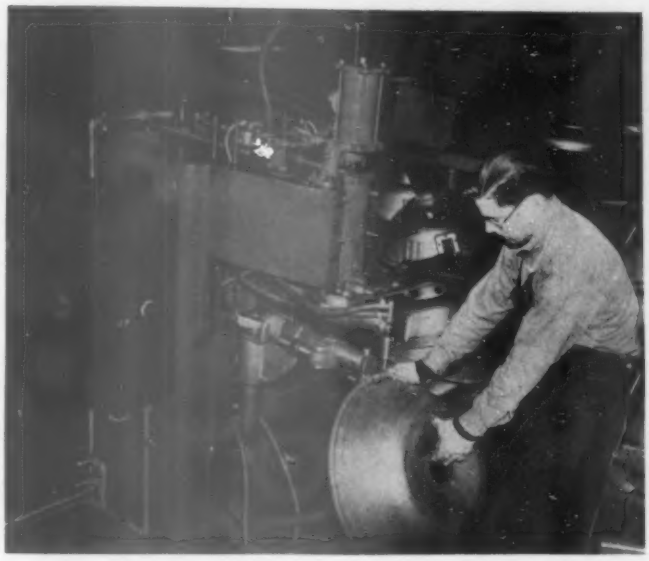
Varying the throat depth or opening, or placing a magnetic material between the arms of the welder, changes the reactance of the welding circuit, resulting in a current output other than that calculated from the turn ratio with average conditions prevailing. Tests show that as the arm length is increased (Fig. 5) and the arm spacing is increased (Fig. 6) the current output will be reduced. A magnetic material such as iron within the throat opening will also decrease the output of the machine in direct proportion to the amount of material in the circuit (Fig. 7). Because of this, a small test specimen will not be comparable to a large work piece, the major part of which extends in the throat opening.

Electrode Variables

The size, shape and material of spot welding electrodes are variables that must be considered when selecting the proper tip for a given job. The electrode diameter should be governed by the thickness of the material welded. The smaller the tip area, the greater the current concentration will be at the spot to be welded. A ball-pointed electrode will produce a higher local pressure and current concentration than a flat-faced electrode, thus usually giving an equivalent weld with from 10% to 15% less power. However, the work will be badly indented from the ball point.

Some engineers maintain that an electrode of the ball-pointed type will insure uniform strong welds in production while a flat-faced electrode will give erratic welds. This is not true; with uniform timing and proper heat and pressure settings, identical welds will be made with flat-faced electrodes throughout a production run. The appearance of the weld will be superior, and the electrode life will be greatly increased.

Electrode material should possess both a high electrical conductivity and the hardness needed to resist deformation under pressure. Copper has high electrical conductivity, but it is relatively soft and quickly deforms. Hence pure copper electrodes will require frequent replacement. Several copper alloys have been developed for electrode material and have given excellent results. These alloys have approximately 85% of the electrical conductivity of copper and a hardness on the order of 80 Rockwell B. Such an electrode will produce from 2,000 to 3,000 spots before mushrooming into an increased tip area of 50%, while a copper electrode will show an increased tip area of 50% after producing from 200 to 300 spots and an increased tip area of 225% after producing but 1,000 spots.



Large dome-shaped parts being spot welded. The electronic control is attached to the machine to save space.

These age-hardening copper alloy tips are very desirable when welding steel, brass or aluminum and will give satisfactory results with silver and silver alloys. Alloys of low specific resistance are welded with electrodes which are either made from special high-resistant alloys or have tungsten or molybdenum inserts to concentrate a large amount of heat at the surface of the low-resistance material and thus prevent it from sticking to the electrode.

Machine Settings

A spot welding operator cannot determine the machine setting for a new job by the use of a formula but must arrive at it by empirical means such as trial and error and past experience obtained from similar work. An operator can approximate a machine setting from data compiled by others, but it is necessary to allow for variations because of the many factors that affect the welding cycle.

After the operator has chosen a suitable electrode, the probable heat tap, the approximate welding time and a desirable working pressure, a spot is made and tested for strength. Should strength be insufficient, either the time or the power or both may be increased, or else the pressure may be decreased. The increase of one cycle in the welding time is equivalent to a 5 or 10% power increase or a decrease of 150 psi in the electrode pressure. In this way, various adjustments are made until the desired weld is secured. More than one setting may produce equivalent welds, but two of the variables involved must differ from those in any other combination.

The characteristics of the metals to be welded influence the determination of the proper machine setting. Steels have a wide plastic range, and will hence accommodate a wide variation in welding time. Aluminum and copper alloys, on the contrary, demand short, accurate welding times. The melting points of some of the common metals are given in Table I.

The specific resistance of a material will aid in determining the current since the greater the electrical resistance, the lower the current necessary to develop welding heat. In Table II it may be seen that silver requires a maximum of power while stainless steel (having a very high resistance) takes a minimum. Copper is taken as 1.00 in this table.

Low Carbon Steel

Mild steel has very desirable spot welding characteristics because time, power, and pressure settings may be varied somewhat. Ball-pointed electrodes produce satisfactory welds, but a flat-faced electrode is recommended for at least one side if appearance is important. Cold rolled steel is satisfactorily welded, and hot rolled steel has even better welding properties. When hot rolled sheet is used, the mill scale should be removed by pick-

ling, shot blasting or grinding. The scale has a high resistance and will cause pitting of the electrode by arcing. The surface of the sheet should also be free of oil and dirt.

When welding mild steel without ignitron timing, the data in Table III may be used to determine an approximate setting. Ignitron timing requires sufficient power to make a weld in a few cycles. The data given in Table IV were obtained with a 200 kva welder, using a ball-pointed electrode against one sheet and a large flat tip against the other sheet to give the best possible appearance.

Table I. Melting Points of Metals

Metal	Melting Point, F
Tin	450
Lead	621
Zinc	787
Antimony	1,166
Magnesium	1,204
Aluminum	1,218
Silver	1,761
Gold	1,945
Copper	1,981
Manganese	2,300
Nickel	2,646
Chromium	2,768
Steel	2,786
Platinum	3,191
Molybdenum	4,500
Tungsten	5,400

Table II. Relative Electrical Resistances of Metals

Material	Resistance Factor
Silver	0.95
COPPER	1.00
Gold	1.40
Aluminum	1.60
Chromium	1.60
Magnesium	2.70
Manganese	2.90
Tungsten	3.20
Zinc	3.50
Nickel	4.50
Platinum	5.80
Steel	5.80
Tin	6.70
Lead	12.80
Antimony	24.20
Stainless Steel	35.00

Table III. Manual Timing for Mild Steel

Sheet Thickness, Gauge	Time, Sec	Pressure, Psi
24	0.4	150
22	0.5	200
20	0.6	250
18	0.7	300
16	0.8	350
14	0.9	500
12	1.0	750
1/8 in.	1.2	900
1/4 in.	2.5	1,200

Table IV. Data for Mild Steel, 200 Kva Welder with Electronic Control
(One Ball-Pointed Electrode and One Flat Tip)

Sheet Thickness, In.	Time Cycles*	Secondary Volts	Weld Current, Amp	Pressure, Psi
0.038	1–2	4.8	11,000	500– 600
0.063	2–3	5.2	12,000	600– 750
0.078	3–4	5.7	13,500	750– 900
0.094	5–6	6.1	15,000	900–1,150
0.125	7–8	9.1	24,000	1,200–1,500

*Based on 60 cycles per second.

Aluminum

Aluminum must reach its melting point during the welding process, and this characteristic necessitates accurate short-cycle control. The machine must have a high current rating as aluminum requires five times more power than mild steel. It is preferable that the electrode close upon the work without a hammer blow; one electrode should be ball- or core-pointed and the other flat-faced. It is advisable to remove the oxide from the surfaces of the sheet adjacent to the electrodes with emery paper or by chemical cleaning methods in order to prevent the aluminum from sticking to the electrodes.

The Aluminum Company of America recommends the aluminum spot welding data given in Table V.

Table V. Spot Welding Data for Aluminum

Sheet Thickness, In.	Time Cycles*	Currents, Amp	Pressure Psi
0.020	1	15,000	200– 300
0.032	1– 2	17,000	300– 400
0.051	2– 3	19,000	400– 500
0.064	3– 4	22,000	450– 600
0.081	5– 6	26,000	550– 700
0.101	6– 7	30,000	600– 900
0.125	8–10	35,000	800–1,400

*Based on 60 cycles per second.

Brass

Brass requires a short welding time at a moderate pressure but with four times more power than mild steel. A ball-pointed tip will produce a weld with less power than a flat-faced electrode, but the machine setting must be accurately adjusted to avoid a hole caused by burning out the zinc at the center of the weld. Two flat-faced electrodes will give very good results with good surface appearance. Pinholes in the center of the welds are not so common with flat-faced electrodes, but they require considerably more power. Data for brass are given in Table VI.

Table VI. Welding Data for Brass

Sheet Thickness, In.	Time, Cycles	Current, Amp	Pressure Psi
0.032	2–3	14,000	450
0.063	4–6	16,000	600

Stainless Steel

Stainless steel (18-8) is an austenitic non-magnetic steel with a very short plastic range and high electrical resistance. It has the property of losing its stainless qualities when heated above 500 C (932 F) for short intervals of time because of carbide precipitation along the grain boundaries. Exceptionally good welds can be secured with welding times of one or two cycles, using flat-faced electrodes and welding pressures considerably higher than those necessary for mild steel. Stainless steel welding data are given in Table VII above.

Table VII. Welding Data for Stainless Steel

Sheet Thickness, In.	Time, Cycles	Current, Amp	Pressure Psi
0.032	1	13,000	800–1,000
0.063	2	14,000	800–1,000
0.125	4	15,000	900–1,200

Projection Welding

Projection or inserts of high-resistance material between the parts to be welded often aid in securing a satisfactory weld. The projections are usually pushed from the opposite side of the sheet and may be spherical, flat, elongated or an annular ring. They should be on the heavier sheet or plate to be welded, have a diameter approximately equal to the sheet thickness and project a distance equal to from 40% to 60% of the sheet thickness. The raised annular ring around a deep center punch mark, or a point raised along the edge of the plate by upsetting with a punch, will often give a satisfactory projection.

Spot welding is still not an exact science. In spite of its many variables, however, the ingenuity of machine builders, accessory manufacturers and welding operators has so advanced the process that it is rapidly replacing riveting as a method of joining metals.

Voodooing the Axis..

These weird creations look like the fetishes of South Sea Islanders or the costumes of Tibetan devil dancers, but they are neither—just weldors' masks and helmets!

Robert A. Laxson, Antioch, Calif.

Dorrance A. Ball, Los Angeles.

Right: Arthur Starbeck, Jr., Racine, Wis.

TO THE LAYMAN, the weldor's helmet, unadorned, appears like something from the pages of *Weird Planet Tales* or *Startling Scientifiction,* but when the aid of the paintbrush is enlisted . . .

Words fail us so we will let the pictures speak for themselves. And what pictures!

These "voodoo masks" were designed by artistically inclined weldors to put the final jinx on Paperhanger Schickelgruber. And they seem to be working, too, if latest reports from the realm of the Third Reich are any criterion.

It all began when executives of the Lincoln Electric Co. viewed a photo of some of the favorite voodoo masks at North American Aviation, Inc., Dallas, Tex. Much impressed, they offered a prize of a new "Procedure Handbook of Arc Welding Design and Practice" (plus the usual $1 compensation) for pictures which could be published in the company's house organ, *The Stabilizer.*

R. C. LaMarre, Cincinnati.

No Winner

As a special inducement, an additional prize of one skull and crossbones was offered for the most horrible looking mask, but the exhibits were all so horrendous that it just wasn't possible to choose between them. Besides, there is a very serious shortage of skulls and crossbones!

Ralph Rogers, Mansfield, O.

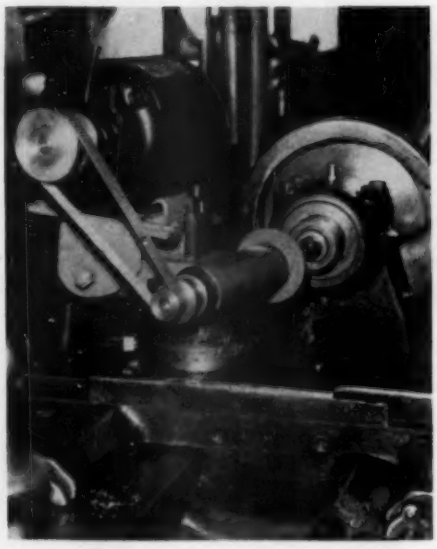
Carl A. Spielmann, Milwaukee.

Howard T. Logan, Greenwich, O.

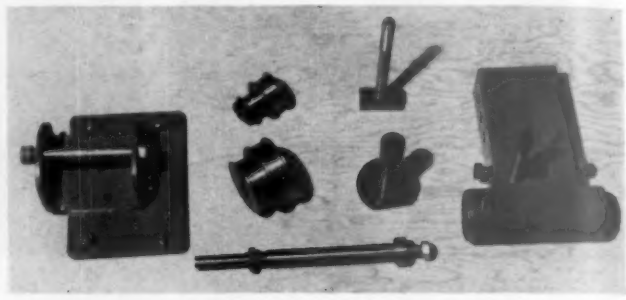
Welded Tool Post Grinder

Called upon to design a grinder attachment for an existing lathe, a practical weldor found that castings weren't needed because the entire device could be made by welding and machining plate stock.

By **F. L. BELL**



The completed grinder mounted on the lathe.



Left to right: motor mounting bracket (inverted), the two pulleys, tool post stud and sleeve, shaft (in foreground) and grinder body. The locking adjustment screws, vertical adjustment screw and belt tension adjustment bolt are shown in place on the body.

THE sturdy tool post grinder pictured herewith can be easily and inexpensively made solely by the welding and machining of steel plate stock.

The body of the grinder, Fig. 1, is a rectangular box made of four 6 in. lengths of ½ in. plate. The vertical pieces are 6 by 2 in. and the horizontal pieces 6 by 2½ in. The latter were fitted inside the vertical sections, giving the box greater width but less height. Wedges or spacers are used to hold the top and bottom sections in place while the ends are being tack welded; after tacking, the full lengths of all four seams are welded. Good penetration is essential as the welds are later to be machined.

Shaft Housing

The housing for the shaft and bearings is made from a 6 in. length of 2 in. shafting with a ⅞ in. hole drilled through the center. The bearing recesses are bored to 1.575 in. diam on one end to a depth of 1¼ in. and on the other end to a depth of ⅞ in. The shallow end will be the grinding-wheel end when the tool is completed.

In order that the body and housing may be fitted together into an integral unit, it is necessary to machine the body. This machining is done with a cutting torch. A distance of ¼ in. is first measured from the top and bottom of the end portion, and lines are drawn across the entire width as shown in Fig. 1 A. The center of the vertical sections is now located and a half circle is scribed on each side of the body. The metal inside the markings can now be cut out with the cutting torch, as shown in Fig. 1 B.

The shaft housing is placed in the half circle cut from the sides of the grinder body and welded; it must be aligned so that the shoulders protrude equal distances from the body as shown in Fig. 2 A. The shallow end will be on the right side of the grinder body.

The necessary machining shown in Fig. 2 B can be done on a lathe having a milling cutter attachment. Both the top and the bottom are to be machined flat in order to form a squared surface.

Tool Post Adjustments

Along the center line of the body, a 1 in. hole is drilled ½ to ¾ in. behind the shaft housing, so as to completely clear the housing. This is to be the tool post hole (Fig. 3 A, *1*). On each side of the body and at a 25 deg angle back of the tool post hole, 7/16 in. holes are drilled and tapped for ½ in. square-headed set screws. These screws (Fig. 3 A, *2*) are to be 1½ in. long and built up by brazing a ¼ in. surface on the ends to prevent galling on the post. They will be used as locking and adjustment bolts for holding the grinder at various angles in relation to the work being held between the lathe centers.

A ½ in. hole (Fig. 3 A, *3*) is drilled to the left of the tool post hole and back from the line of the housing; this is tapped for a 9/16 in. square-headed set screw, 4½ in. long. This is the vertical adjustment screw which goes through the body and adjusts its height above or below the center line of the lathe spindle.

Location of the motor support bolt, onto which the swivel bracket is attached, is shown by Fig. 3 A, *4*.

At the right and slightly behind the tool post hole, a 7/16 in. hole is drilled and tapped for a ½ in. cap screw,

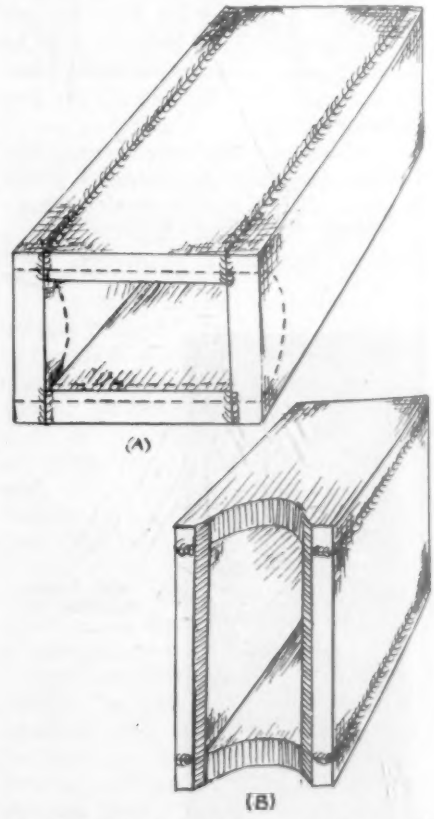


Fig. 1—Grinder body before (A) and after (B) flame-cutting the recess for the bearing housing.

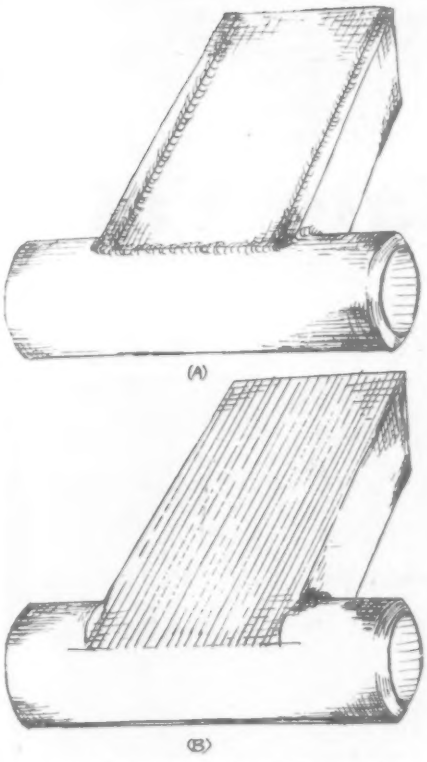


Fig. 2—Body with bearing housing welded in place (A); after machining (B) to obtain true surfaces for tool carriage mounting.

1½ in. long. The motor will be mounted directly above this cap screw (Fig. 3 A, *5*) which is raised and lowered to adjust the tension of the belt.

The pulley end of the shaft is shown at the left (Fig. 3 A, *6*) and the grinding-wheel end at the right (Fig. 3 A, *7*).

Tool Post and Sleeve

The tool post is made up of two parts: a ½ in. stud, 5 in. long, and a sleeve, 3½ in. long, with a flanged base. The stud (Fig. 3 B) is threaded into a base slotted to fit the tool carriage of the lathe. The sleeve (Fig. 3 C) measures 1 in. OD and ⅝ in. ID to fit over the ½ in. stud; the flanged base is 3 in. in diam and ⅛ in. thick. When the base is in the lathe slide rest, the sleeve encircling the stud goes through the tool post hole, and the nut at the top tightens against the sleeve, thus giving a steady support to the grinder and protecting the bolt of the tool post.

The mounting for the motor is a ¼ in. steel plate with bolt holes in the four corners to correspond with the holes in the motor casting. The mounting bracket is also of ¼ in. steel, 8½ in. long and 3 in. wide; it is bent to fit around three sides of the grinder and provide a swiveling action for the motor. The bracket laps far enough over the sides to match its bolt holes with those in the back of the grinder and is welded in an offset manner to the flat base in order to align the belt so that it will run true between the motor and the base.

This grinder was designed for a ⅓ hp motor developing 3,600 rpm, although a slower speed or motor of less horsepower can be used if desired.

Grinder Shaft

The shaft (Fig. 4) is made of 1⅛ in. chrome-vanadium steel and is 9½ in. long. Starting at the left or pulley end, it is turned on the lathe to ½ in. for the first 2 in. (Fig. 4, *1*). For the next ⅞ in., it is enlarged to ⅝ in.; this section (Fig. 4, *4*) is to be threaded with ⅝ in. thread.

The next section (Fig. 4, *8* as well as *10*) is to contain the bearing shoulders. This part of the shaft must be turned with precision since only 0.0005 in. tolerance can be allowed. The bearing ID being 0.6693 in., the 1 in. length of shaft constituting the bearing shoulder should be turned to a diameter no smaller than 0.6698 in. to allow the bearing to be lightly press-fitted to the shaft.

Between the two bearing shoulders is a 3½ in. length of shafting (Fig. 4, *9*) which can be turned 0.020 in. smaller than the bearing shoulders. The second shoulder measures exactly the same as the first. Beyond this second shoulder, the shaft enlarges to 1 in. for a distance of 1/16 in., then a shoulder of the entire 1⅛ in. diameter is left for the next ½ in. (Fig. 4, *12*). The remaining one inch of the shaft is turned to 7/16 in., and the last half inch of this is threaded with a 7/16 in. national fine thread.

In applying the bearings (Fig. 4, *7* and *11*) caution should be used against too tight a pressure to avoid swelling the inner bearing case, which would cause the bearing to turn hard and eventually fail in service. The shaft should turn freely after it is installed in the housing.

To assemble the shaft, one of the bearings (Fig. 4, *11*) is fitted to the right of the 1⅛ in. permanent shoulder (Fig. 4, *10*). The shaft and bearing are placed in the housing, and the other bearing (Fig. 4, *7*) is then pressed into place. Next to this bearing, on the threaded section, is placed an ordinary ⅝ in. nut (Fig. 4, *6*) and then a ⅝ in. lock nut (Fig. 4, *5*).

The shaft pulley (Fig. 4, *2*) has a ½ in. hole and reduces from 1½ to 1 in.; it is held in place by an Allen screw (Fig. 4, *3*) that tightens into a flat spot on the shaft at this point. The two-step drive pulley used on the motor reduces from 2½ to 2 in., and the belt is a 21 by ⅝ in. flat belt. Because of the extremely high spindle speed of the lathe (3,600 rpm), a V-belt drive should not be used; it is not flexible enough for this type of work and would cause vibration.

On the wheel end of the shaft, the grinding wheel (Fig. 4, *13*) is placed next to the permanent shoulder. Next to the wheel is placed a 7/16 in. shoulder washer and a 7/16 in. nut. (Fig. 4, *14* and *15*).

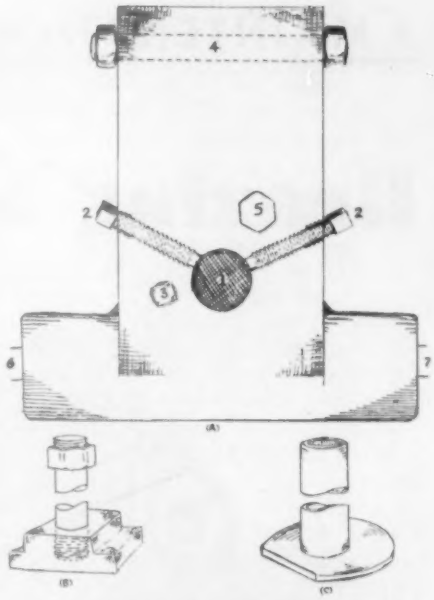


Fig. 3—Plan view (A) showing method of mounting grinder and tool post on lathe tool carriage. (1) Tool post hole, (2) locking adjustment set screws, (3) vertical adjustment screw, (4) motor support bolt, (5) belt tension adjustment bolt, (6) pulley end of shaft, (7) grinding-wheel end of shaft. The two small drawings show details of the tool post (B) and sleeve (C) to protect tool post bolt.

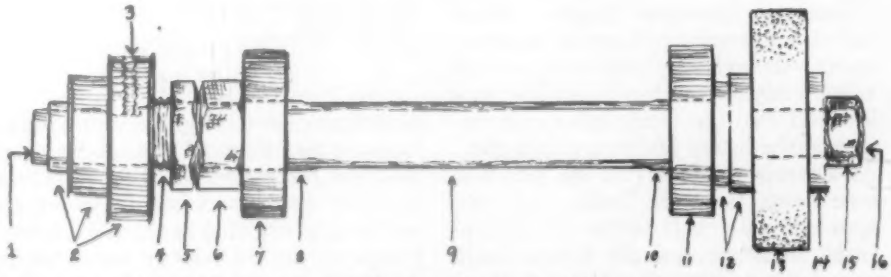


Fig. 4—General assembly drawing of shaft. (1) pulley end, (16) grinder end, (2) pulley, (3) Allen screw, (4) threaded section, (5) lock nut, (6) ordinary nut, (7 and 11) bearings, (8 and 10) bearing shoulders, (12) shoulder for grinding wheel, (13) grinding wheel, (14) washer, (15) nut.

Brazing a Broken Gate Valve

Sixteen in. welded pipe line being lowered into the ditch. It was during this operation that the accident occurred to the gate valve.

The pipe line had to be put in service without delay so the oxy-acetylene torch and the welding arc were called on to effect the speedy, economical repair of a cast iron valve. Water was turned into the line as soon as the casting had cooled—no breaks, no leakage.

By HARRY KERWIN

OXY-ACETYLENE and arc welding equipment complement and do not supplant each other in repair work and fabrication. Nowhere was the practical use of both welding processes in a major repair job better demonstrated than in the restoration of a broken gate valve that had been damaged during the installation of a 16 in. welded pipe line bringing water from the mountains to a California city.

Due to improper rigging which failed to provide adequate support, undue strain was placed upon the valve body when the pipe line was lowered into the ditch, after installation of the heavy 16 in. cast iron gate. As a result, the flange on one side was torn loose from the main body for approximately half of its circumferential distance, and the flange itself was broken into three pieces (see sketch).

A replacement gate valve, even if available, could not be obtained for at least several weeks, and it was necessary to have the pipe line in operation as soon as possible. The only answer was, of course, to undertake the repair of the broken valve body by welding.

Reasons for Brazing

Brazing was the selected welding method for reasons of speed, economy and the fact that it may be used on cast iron with a minimum of preheating. Also taken into consideration was the high tensile strength of a good brazed joint—even greater than that of the original casting.

The next question to be settled was whether the repair was to be made in a shop or in place. To do the job in place would necessitate welding in close, cramped quarters in the difficult overhead position. But the labor of removing the heavy gate valve and transporting it to the nearest shop was considerable and would take much valuable time. Because the time element was so important, it was decided not to remove the valve but to do the job in place.

Tack Welding

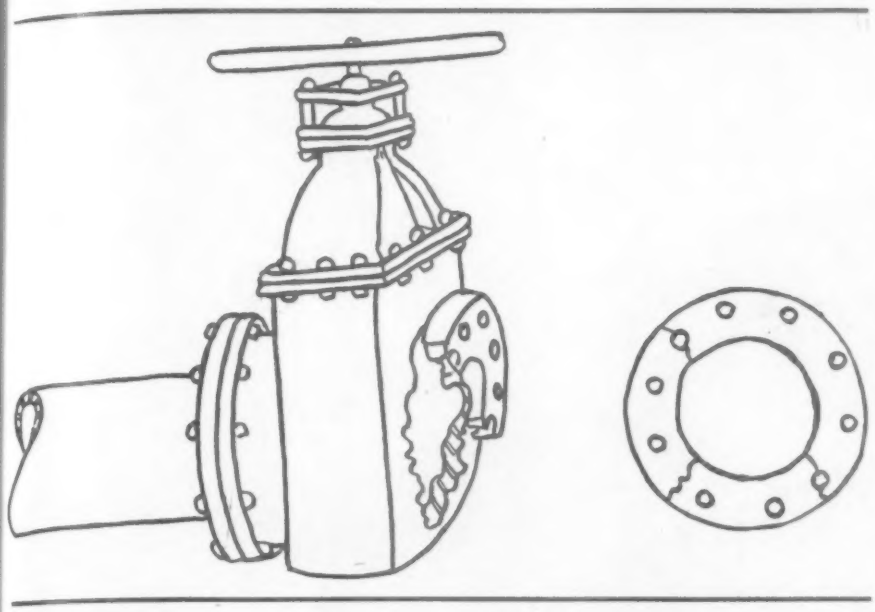
Before undertaking the actual brazing, use was made of the arc welding machine for tacking the broken pieces together in alignment. In order to secure perfect alignment, the broken pieces of the cast flange were bolted to the face of the steel flange. The pieces were tacked together with a cast iron electrode, and the tacked section was then removed from the steel flange and fitted into its proper place in the valve body.

A careful check was made to insure correct spacing of the bolt holes and trueness of the flange face before the entire crack was tacked with the cast iron electrode. The tacks were each 1 in. long, and they were spaced at 6 in. intervals. Because of the speed of the arc, the tacking did not necessitate any preheating and no distortion developed.

Edge Preparation with Arc

There were three methods which might have been used for veeing out the crack preparatory to brazing: chiseling out the crack by hand (a slow, laborious process), flame-cutting and arc cutting. In this case, it was felt that the oxy-acetylene torch, the generally accepted method, could not be used because of the heat factor which would have a tendency to cause distortion. The arc method was decided upon because of its speed and economy and the fact that the heat escaping into the casting would be kept at a minimum.

Arc cutting offers a means of obtaining high temperature at a low heat production cost and is especially suited for materials such as cast iron which will not oxidize readily. Though the carbon arc is probably the most satisfactory for cutting, the metal arc makes an efficient substitute where carbon electrodes and their special holders are not available. In this case,



Sketch showing how flange was torn loose from valve body and broken in three pieces.

the cutting was done with 1/16 in. reverse polarity (AWS E-6010) coated electrodes while the machine was set for straight polarity at 40 volts, 190 amp. The electrodes were each immersed in water for approximately two minutes prior to use in order to prevent the flux coating from burning off before the electrode was entirely consumed.

Preheating

Though the torch could not be used for the actual cutting, it was useful for local preheating. The area of casting around the crack was torch warmed in order to lessen the heating effect of the cutting upon the cast iron. The crack was veed from both sides, leaving at least 1/8 in. in the center to aid in keeping the proper spacing and to prevent distortion. As the bond between bronze alloy and iron is of much greater strength than cast iron, the quality of the joint was not lowered by leaving the central portion uncut.

The space between the tacks was the first to be veed. After these spaces had been brazed, the tacks also were cut out by the arc process. It cannot be too strongly emphasized that the success of the entire job depended in large part upon the fact that the heat escaping into the casting during the cutting was kept to a minimum.

Rapid Cutting

The cutting was done very rapidly —much faster, in fact, than it could have been done by any other method. The arc made a deep and narrow cut, an important consideration as it lessened the amount of brazing alloy used. Another advantage of the arc was the roughened, porous surface it produced—an ideal surface for brazing since the strength of a brazed joint is determined by the depth the bronze is able to penetrate into the pores of the casting.

Brazing Procedure

As previously explained, the spaces between the tacks were first brazed; then the tacks were cut out and the spaces thus produced were brazed in their turn. In this way, there was always some metal in place to hold the alignment. The initial brazing was done in four 1 in. sections spaced about 6 in. apart. A low heat tinning flux and a good medium heat brazing flux were used. The first pass was made with a 1/8 in. bronze rod, the second with a 3/16 in. rod, bringing the weld flush with the top edge of the bevel, and the final pass with a 1/4 in. rod.

Since the crack had been chamfered for a double vee joint, the welding was done on alternate sides. This equalized the stresses set up by cooling and prevented the face of the flange being drawn out of line in either direction. Each weld section was peened as soon as deposited in order to release as much as possible the locked-up stresses of the cooling metal.

The success of this job had to depend entirely upon the materials and techniques used. It must be remembered that the work was done in place on the pipe line, in an open gate valve body and without preheating facilities other than the limited local preheating which could be obtained from the welding torch.

The first or tinning pass is by far the most important on any brazing job, for it is then that the actual braze is obtained. The subsequent passes are literally "bronze welding" in the sense of joining bronze to bronze, for the first pass is melted only enough to fuse the added metal, never enough to re-expose the casting. Hence the ultimate strength of a brazed joint depends largely upon the success of its tinning pass.

On this job, the torch was adjusted to a slightly oxidizing flame for the all-important first pass. This type of flame furnished the intense heat that was needed to open thoroughly the pores of the cast iron along the bevels. The entire surface of both bevels was thoroughly tinned with a bronze coating approximately 1/8 in. thick. The tinning extended for 1/8 in. past the top edge of the bevels in order to guard against any possible flaw at the edge of the weld.

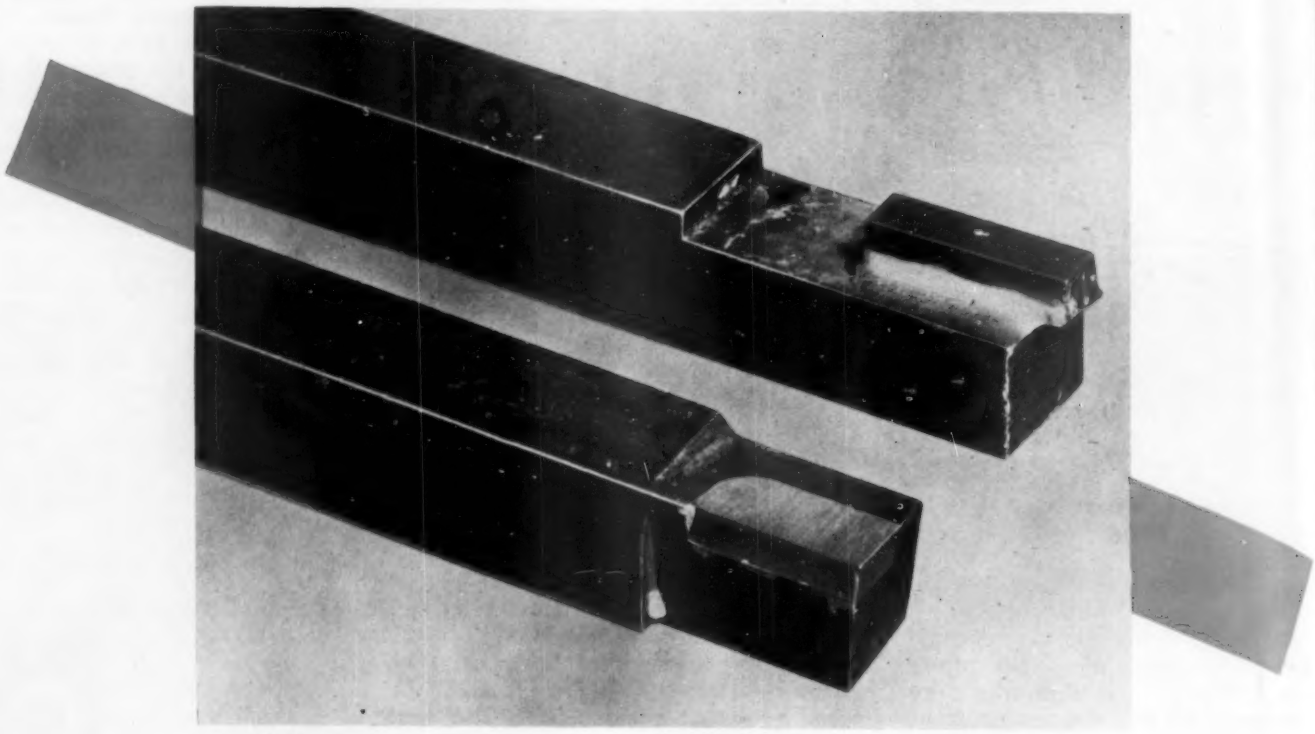
The Low Heat Flux

That it was possible to weld the casting without standard preheating facilities was due, in large part, to the efficiency of the low heat flux used on the first pass. It was necessary to bring the casting to a dull red color only immediately in front of the puddle in order to establish thorough tinning when, to use a weldor's colloquialism, "the bronze runs like hot butter." The red color never extended past the tinned surface along the top edge of the bevels, and there was no color remaining in the casting when the torch was lifted from the puddle.

It is needless to waste flux but, it might be well to point out, it *is* necessary to use an adequate amount. There must always be flux on the brazing rod when the weld is in progress. The low heat flux was used only the first pass, the braze being completed with the medium heat brazing flux.

Between deposits, the flame was played over the area around the crack but only enough to keep the casting warm to the touch. There was no color in the casting while the finish passes were being applied. The torch was also used to keep the deposited metal in a plastic state while the surplus metal across the face of the bevel was scraped off with a coarse file. This operation left a smooth surface.

Water was turned into the line just as soon as the casting had cooled enough to stand it. The success of the job is indicated by the fact that the brazed joint has shown no fractures nor leaks after 30 days under maximum load.



Two methods of joining tungsten carbide tips to the shanks of lathe cutting tools.

End Cutting Tool Absenteeism!

Absentee tools contribute as little to the war effort as absentee workers. And there is no excuse for tool absenteeism today when broken cutting tools can be so quickly salvaged by low-temperature brazing methods

By **H. W. FOEGE***

IT WAS easy in the prewar past to discard and replace that which had become slightly worn but had not outlived its usefulness, to buy a new article instead of repairing a broken one. Not so today! We are finding out through painful experiences that we *can* suffer from shortages, great though our resources are. We are learning many hard lessons: how to use substitute materials, how to prolong the life of tools and machines, how to produce two units where but one has been produced before.

Cutting Tool Shortage

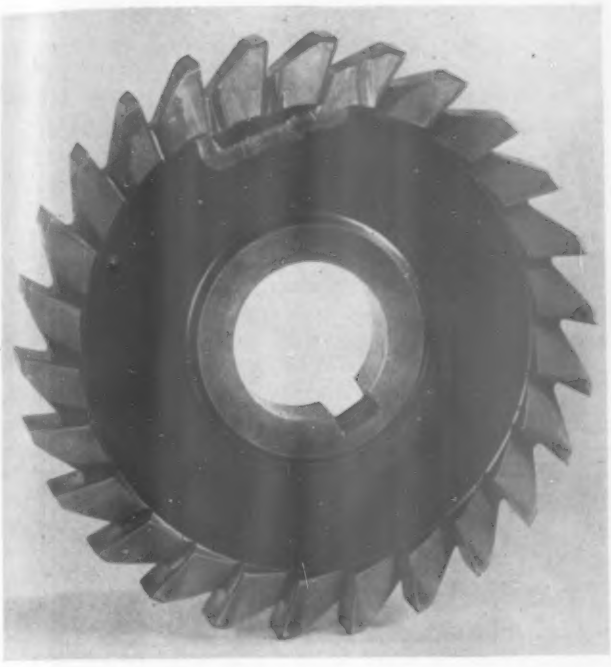
Since Pearl Harbor, the need for cutting tools of all types has multiplied many times. Made of critical materials and being naturally expendable, lathe tools, milling cutters, drills, broaches, reamers, etc. represent one of our most serious bottlenecks. Despite the heroic efforts of tool manufacturers to supply them, cutting tools remain difficult to obtain, and their lack often threatens production, sometimes vitally. Instance after instance can be cited where a whole production line has been held up for want of a single tool—a broach or a reamer or an end boring mill cutter. Thus it is scarcely surprising that the repair and salvage of worn and broken cutting tools is today occupying a large proportion of the thoughts and time of war goods producers. Absentee tools are no more wanted in war plants than absentee workers.

Fortunately indeed, low temperature brazing materials and processes have been developed whereby (1) broken tools may be quickly and easily repaired, (2) new tools may be made—either in whole or in part —from scrap high speed steel and (3) plain carbon steel may be tipped with high speed steel, special alloys or tungsten carbide. All of this may be accomplished at low temperatures and without need for subsequent rehardening.

Tool Salvage by Specialists

Pioneered largely by The International Harvester Co., one of the world's largest users of perishable tools, many of these low temperature brazing procedures are finding a constantly expanding use in a long list of representative industrial concerns throughout the United States. As an example of their efficacy, we quote a gentleman having direct su-

*An abstract of a paper given at the annual meeting of the American Society of Tool Engineers, Milwaukee.



This milling cutter lost several teeth, which were replaced with teeth taken out of a scrap tool. The added teeth were brazed with a low temperature (1,300 F) alloy so that little if any hardness had to be sacrificed.

pervision over tool salvage work in one important plant: "More than once our engine production would have stopped had it not been for the availability of a cutting tool that had been repaired by low temperature brazing."

It is the purpose of this paper to discuss some of the ways and means of making these repairs, describe some typical applications and to give details of the alloys suitable for this important work.

First, it is important to recognize that the greatest benefits are to be derived by establishing a tool repair center and placing all work of this nature in the hands of one, two or as many operators as may be necessary to handle the volume of work at the given plant. The ability to use the brazing alloys at their proper temperatures is a highly important facility as the operations are conducted at temperatures close to the point at which tools will lose their hardness. These tool salvage specialists also become highly skilled in devising alignment fixtures. Their work requires patience and close attention to detail, but it will not only keep tools in service but result in actual monetary savings. In the case of one large user, the savings from tool repair in one year amounted to some 14% of the total cost of all tools. Individual savings may run as high as 50% on some tools. This is, of course, incidental as the primary object of a tool repair center is to keep the tools in production.

Required Equipment

Besides men, the essentials required for tool salvage are grinders, wire brushes, emery cloth, carbon tetrachloride, soft bristle brushes, fixtures and clamps for alignment, evenly surfaced steel plates for use in repairing slitting saws and flat milling cutters, etc. To this list must be added the brazing alloys with their proper fluxes and regular oxy-acetylene welding equipment, including single and double flame torches and an assortment of various sized tips. Sandblasting equipment can sometimes be used with excellent results since the low temperature alloys referred to will flow and bind on sandblasted surfaces. Sandblasting is also useful in the removal of brazing material that may have failed because of slippage and may have become oxidized or inadvertently overheated.

The fixtures are usually devised as the different types of tools come into the salvage center. They may range from a simple V-block cut away at the center to elaborate spring tension fixtures with positioning screws and plates to take care of tapers. Both horizontal and vertical fixtures have their places.

The Brazing Alloys

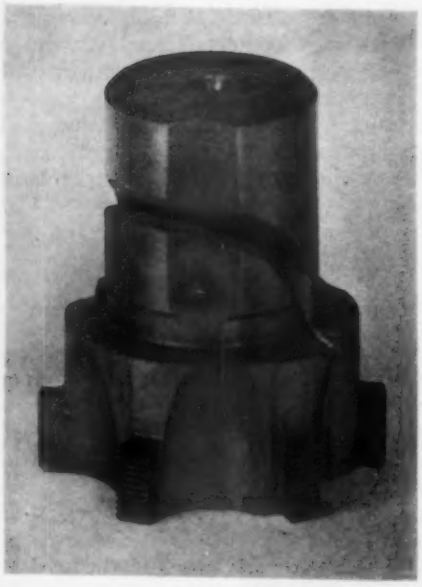
The alloys used to make the joints are of greatest importance. The alloys here referred to are the Castolin Eutectic low temperature welding rods—more specifically, three copper base alloys of the nearly 50 alloys included in this line. These alloys are distinctive in character and performance and are not to be confused with ordinary brazing rods, welding rods and silver solders. In other words, they are entirely new in this field.

The three alloys particularly adapted to tool salvage have binding temperatures of 1,300 F, 940 F and 1,000—1,200 F. Binding temperatures should not be construed as the melting point of the alloy but rather as the surface temperature of the parts being joined.† The alloys having the highest and lowest binding temperatures combine high strength (average tensile strengths of 117,000 and 53,000 psi, respectively) with the ability to flow through tight-fitting joints in any direction by capillary attraction.

The 1,000—1,200 F alloy does not have the same penetrating qualities as the other two and is most often used to fill in holes, to build up such tools as broken dovetails and tangs and sometimes to fill in chamfered joints.

†In reality, the melting point of the alloy may be several hundred degrees above the binding temperature. Naturally, the alloy used must be melted, but this should be accomplished by directing the flame in such a manner as to melt the alloy without heating the base metal above the binding temperature—*The Editors.*

Repaired high speed steel dovetail tool. The broken section was rebuilt with the 1,000-1,200 F copper base alloy.



Many broken tools are joined as broken, but this large tap was an exception. Note that the chamfer was ground from both sides of the break.

Though this alloy contains no silver, it is usable with the facility of materials of that nature. Not only will it flow through tight-fitting joints, but, because of its great natural strength, can be used equally well in chamfered joints, to make butt joints with comparatively wide spacing and to fill in voids where pieces may be missing. It machines readily, has excellent wearing qualities and a Brinell hardness of 180 to 220. Obviously, it is not for cutting edges.

These alloys are customarily furnished in the form of rods. They may also be obtained in powder form for preplacing purposes. The 940 F alloy is also made in strips down to 0.003 in. thick.

Temperature-Indicating Fluxes

Each of the alloys mentioned above has its own fluxing paste, which always bears the same number as the alloy. In addition to serving the usual functions, each flux also serves as a temperature indicator since it becomes fluid at the binding temperature of its companion alloy. This feature is of great importance when working with high speed tools, which are often ruined by overheating.

The oxy-acetylene torch is the most commonly used heating method. The alloys, however, are adaptable to other heating media such as the carbon arc, the atomic-hydrogen arc, furnaces having either oxidizing or reducing atmosphere, salt baths, resistance welders and high frequency induction coils.

Except with torch, carbon arc and atomic-hydrogen arc, higher temperatures are required; *i. e.*, several hundred degrees above the binding temperature of the particular alloy in question. This fact renders the alloys unsuitable for use on high speed steel in furnace brazing although they are satisfactory for joining tungsten carbide tips to carbon and alloy steel shanks. Because of its ability to withstand higher temperatures, the 1,300 F alloy has been successfully used in furnace brazing and simultaneous hardening of high speed steel at 2,300 F. This, however, must be done in a reducing atmosphere.

Service Records

Cutting tools repaired by these methods may be depended upon to deliver full service, often outlasting new tools. To the limit of their usability, they will stand grind after grind until there is insufficient stock left for further reduction. Let us give an example or two:

One of the major aircraft producers repaired an expensive broach which had broken on its fourth operation. Since the repair was made, the broach had performed 15,000 operations up to the time last reported upon.

Another producer of heavy machinery has a large number of broaches, drills, reamers and cutters that have been in daily operation for more than a year since they were repaired. Some of these had two and more breaks when repaired. Numerous other examples could be cited along these same lines.

Money Savings

Reference was made earlier to monetary savings so a few examples of the cost of low-temperature brazing may prove interesting:

An extension reamer made of two worn out reamers. Cost of new tool, $18; cost of reclaiming, $3.

A spline broach. Cost of new tool, $180; cost of reclaiming, $4.

A slitting saw. Cost of new saw, $24; cost of reclaiming, $5.

A circular milling cutter. The section broken out was repaired by grinding a section of another broken cutter to fit and then brazing it in place. Cost of new cutter, $23; cost of reclaiming, $7.20.

The above figures include all labor and material used and include overhead. The actual cost of the alloy used to make the joint did not in any case exceed a few cents.

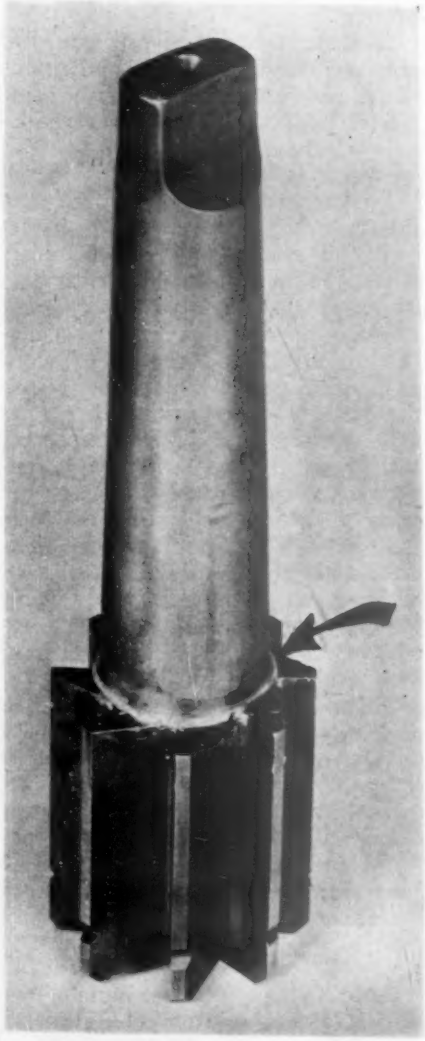
Repair Procedure

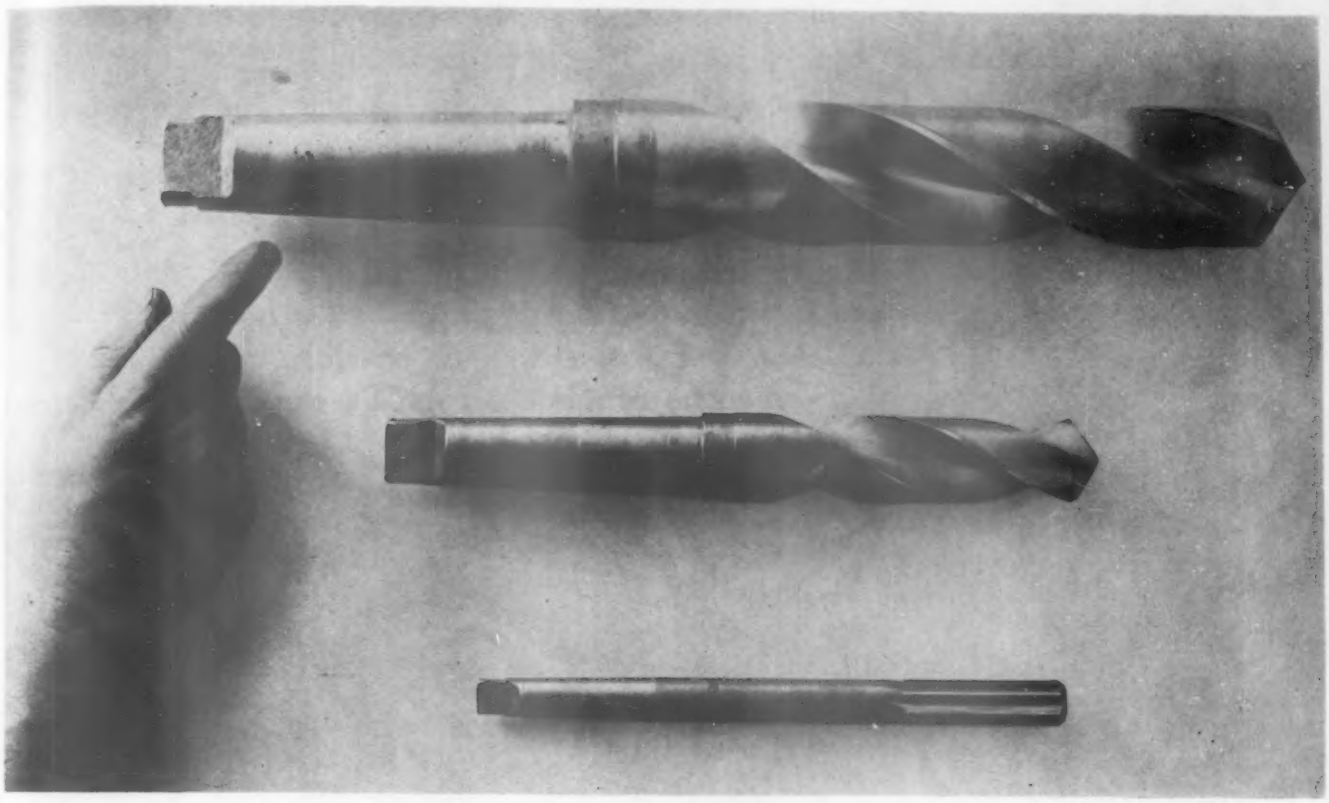
In making these repairs, the parts must be thoroughly clean. All grease must be removed with carbon tetrachloride, using a soft bristle brush. Scale, rust or deposits or other foreign metals must be removed by either grinding, filing, or sandblasting. Except where chamfering is necessary, it is preferable to join the broken pieces as broken. Grinding should, of course, be done where it is necessary to secure proper alignment as when making a new tool from scraps of old tools or in combination with low carbon steel. Other tools that are invariably ground are broken circular milling cutters and saws and, sometimes, very large tools. This is done so that only the chamfered surface will be heated, avoiding all possibility of spoiling the hardness of the cutting edges. In these cases, the chamfer is made from both sides, leaving intact a thin section in the center extending the full length of the fracture.

Fluxing

The next step is the application of the proper flux for the particular alloy to be used. The flux should be used liberally and should be added frequently. Pains must be taken to insure that the surfaces and adjacent

Another milling cutter with a new shank that was brazed on with the 1,300 F alloy.





These three drills were put back in service by brazing on new tangs at 1,300 F.

areas are wholly covered with flux.

Preheating is usually desirable though not invariably necessary. Some users preheat the tools to 400-500 F to minimize heat stresses. The fixtures and plates used for flat milling cutters and saws are also preheated.

For the brazing operation, the torch is adjusted to give a slightly reducing acetylene flame for the 1,300 F alloy and a greater excess acetylene flame for the 940 F alloy. Torch distances of from 1 to 5 in. are maintained. The heating should proceed slowly and carefully while close attention is paid to the reaction of the flux, which liquefies at the proper time for the addition of the alloy (unless alloy is preplaced). The torch is kept in motion throughout the entire operation. Uniform and complete heat penetration to the proper degree throughout the entire area to be joined is essential. Otherwise, flow by capillary attraction will not be achieved.

A precoating technique is usually employed with the low binding point alloy. A steel rod flattened on the end can be heated and rubbed into the molten alloy to assist in the precoating. One or both surfaces may be coated; usually, it is only necessary to coat just the one surface. After precoating, the part is again fluxed as is also the uncoated part. The latter must, of course, be brought up to the equivalent temperature of the coated part so that both pieces will heat at a uniform rate when the braze is accomplished.

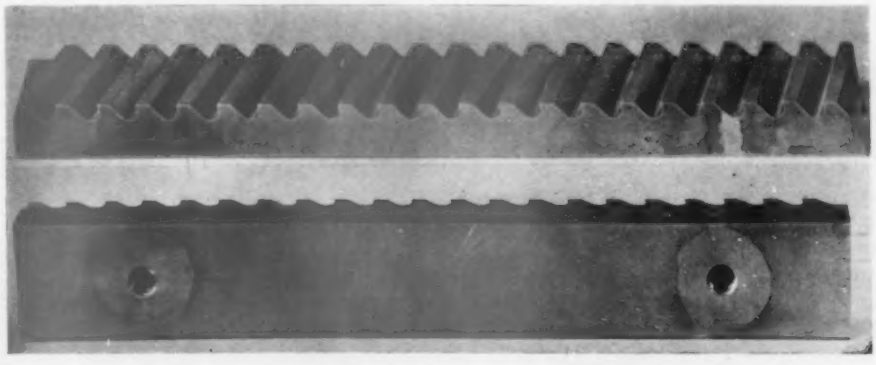
Loss of Hardness

The 1,300 F alloy may be used in all cases where great binding strength is required and a slight local loss of hardness does not matter. Although its binding temperature of 1,300 F may be considered as rather high for high speed steel, there is no important loss of hardness in most cases because the tool being repaired is not held at brazing temperature for any length of time.

On certain types of tools, a slight loss of hardness has no effect on the ability to deliver full service. In this category are broaches, circular milling cutters, saws and drills broken through the flutes. Moreover, it will be found in many cases that it is not necessary to complete the braze to the outermost cutting edges (as in a circular milling cutter, for instance).

Such tools as surface broaches may be chamfered from the back partially through, say two thirds to three fourths of the dimension from the flat surface to the root of the teeth. The alloy has sufficient strength to make this quite adequate.

Where full hardness must be maintained, as in reamers, boring mills, high speed inserts and the like, then the lower binding temperature (940 F) alloy is used. There is no loss of hardness when this alloy is properly used. The alloy does not have the strength of the 1,300 F alloy, but tools repaired with it will give service until worn out.



Oblique and bottom views of a repaired broach, put back on the job with low temperature alloys.

Bad News for Nazi Subs

Subchasers are now being turned out on schedule because F. J. Valentine refused to quit when he couldn't secure castings for propeller shaft bearings and found a way out when he couldn't get the bearing struts machined.

By **J. H. SAUNDERS**

WOODEN-HULLED subchasers may represent a reason why Herr Hitler has been losing the Battle of the Atlantic. As in all shipbuilding, welding and flame-cutting are used to facilitate the construction of these vessels which are wreaking so much havoc among Nazi U-boats.

Production and priority difficulties are not permitted to stand in the way of prompt deliveries on subchaser parts. One incident will serve to illustrate this. A Brooklyn manufacturer, F. J. Valentine, Inc., tried to order castings for the propeller shaft outboard bearings. The foundries were loaded to capacity and could not take on any more work, even for the Navy. Then he hit upon the idea of drilling rolled solid rounds and was rebuffed again when he shopped the steel mills. His last hope was to use heavy seamless tubing. After a considerable search, he finally located an outlet able to supply tubing of the required diameter and wall thickness.

Set-up for Flame-Cutting

To make these bearings, it was necessary to cut the tubing into short lengths. Obstacles again arose. Power saw equipment and friction saws were unobtainable, for one reason or another, and job shops were either unwilling or unable to do this part of the work. Necessity mothered an invention—an ingenious emergency set-up for cutting the tube with an oxy-acetylene torch.

Because extensive machine equipment could not be obtained, the cutting device was made up of odd parts and gadgets, including an old drill press, which had been gathering rust around the shop. This unimposing but very practicable contrivance is shown in Figs. 1 and 2. As may be gathered from the illustrations, its

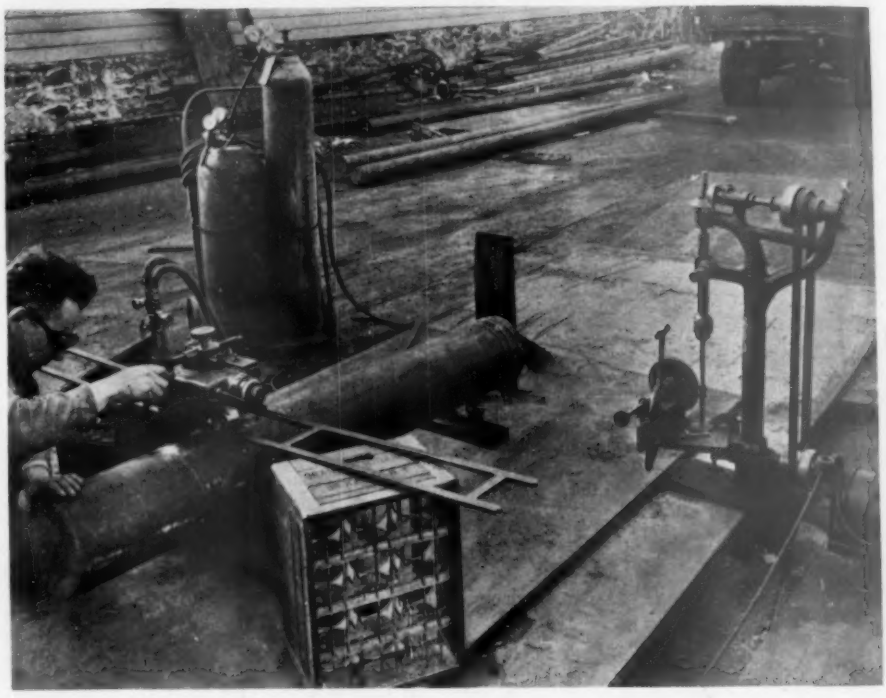


Fig. 1—This ingeniously contrived set-up enables speedy emergency cutting of heavy-walled tubing. Note how the drill press and dollies are used to rotate the tubing.

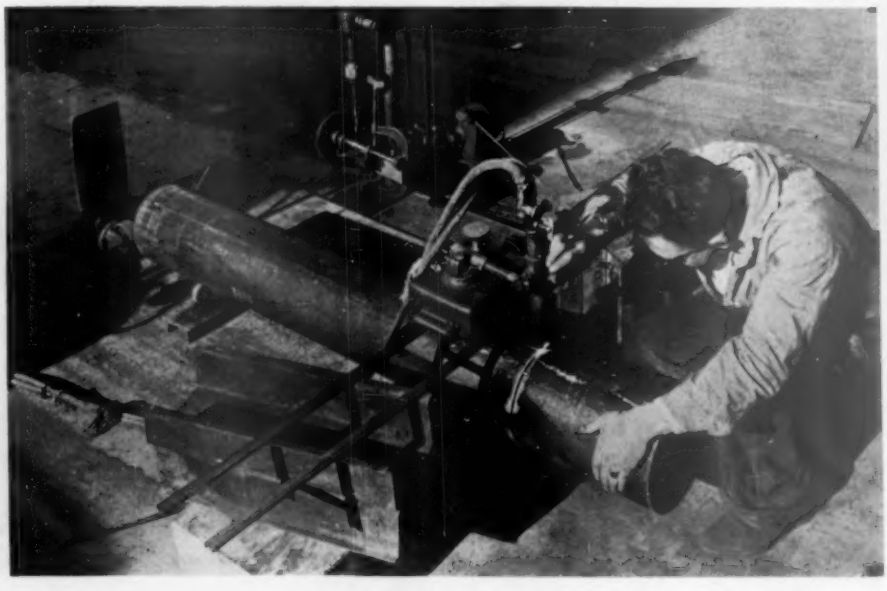


Fig. 2—A better view of the worm mechanism attached to the drill press for reeling in the wire. This illustration also shows how the tube is butted against the vertical roller at the far or "drive" end to prevent end-play movement during cutting.

TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge: Nominal Pipe Size	Light Gauge: Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-14"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-14"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-14"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	½"-24"	½"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	¾x¾-24x20	¾x¾-24x20	¾x¾-12x10	1x¾-8x6		
Reducers	Concentric & Eccentric	1x¾-24x20	1x¾-24x20		1x¾-8x6		
Caps		¾"-24"	¾"-24"		1"-8"		
Stub Ends	Lap Joint	¾"-24"	¾"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"					

*30" size short radius.

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".

Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	¼"-24"	¼"- 4"		¼"-3½"			
Socket Type	¾"-24"	¾"-24"	¾"-24"	¾"-24"	¾"-24"	¾"-12"	¾"-12"
Reducing-threaded or slip-on		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—threaded		1"-24"					
Orifice—slip-on		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Orifice—welding neck		1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	
Long Welding Neck	1"-24"	1"-24"					

†Dimensions on sizes thru 3½" same as for 400 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

TUBE-TURN (TRADE MARK)

Welding Fittings and Flanges

★ The ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST

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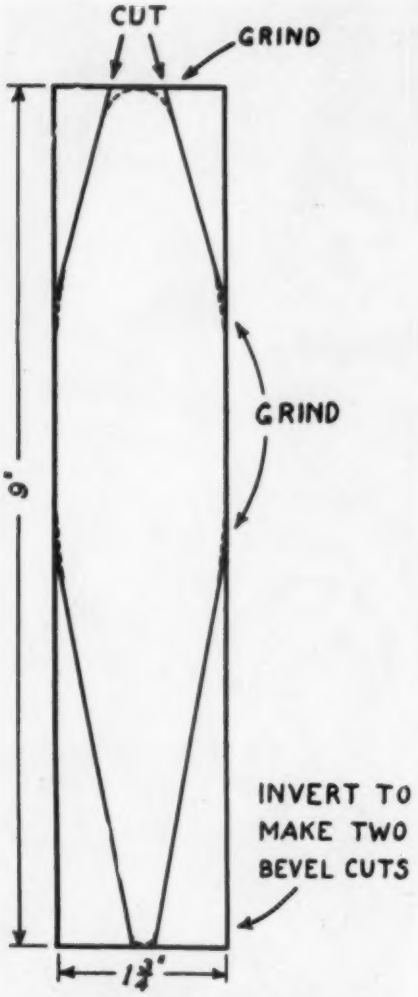

Fig. 3—Edge section of strut member shaped from 1¾ in. plate. The four bevel cuts are supplemented by grinding to provide the proper streamlined shape.

purpose is to support and rotate the tubing beneath a stationary cutting torch.

Rotation is provided by the drill press which, through a worm gear reduction, slowly reels in a wire previously wrapped around the tubing. The circumferential speed of the tube, regulated to conform to torch cutting speed, remains constant at one revolution in three minutes as the wire is drawn in and coiled around a ½ in. shaft. The rollers of a pair of dollies support the tube during rotation.

One of the dollies is elevated a few inches to pitch the tube downward toward the "drive" end where a roller is welded to a vertical support, as shown in Fig. 2. This roller butts against the end surface and thus eliminates end-play movement during the cutting, which is done at the opposite end.

The tubing measures 9¼ in. OD, 6 in. ID; it weighs 150 lb per ft and is cut into 13¾ in. lengths. Holes 3/16 in. in diam are drilled for starting each cut. After cutting, the tube lengths are machined-faced at both ends and bored to receive a bronze sleeve and a micarta oilless bearing. The original specifications were modified to permit the use of the micarta bearing, thus saving considerable Babbitt.

Flame-Machining Struts

Since the twin propeller shafts project for some distance underwater between the points where they leave the hull and the propellers, the submerged bearings must be supported by struts. To reduce friction, the struts are streamlined to the "tear drop" cross-section shown in Fig. 3. Here the manufacturer hurdled another obstacle. Lacking a shaper machine and unable to subcontract this part of the work, he developed the idea of flame-machining these parts with a motor-driven cutting machine.

Plate stock 1¾ in. thick is first cut into strips 9 in. wide. These sections are set up on edge beneath the torch of a portable cutting machine, and four deep bevel cuts are made successively as shown in Fig. 3. The rough tear drop shape thus produced is finished by grinding along the lines of the cut to round off the forward and trailing edges of the strut members.

The cutting and grinding operations together, it was found, consumed less time than would be required for machining even if the proper machines were available. As a minor point (and yet perhaps not so minor either), it might be mentioned that the use of flame-cutting saves wear on cutting tools, of which there now exists a critical shortage.

Use A-C Electrodes

The struts are welded to the sleeves with heavy coated A-C electrodes of AWS designations E-6020 and E-6013. The downhand electrode, E-6020, is used to lay the first bead, while E-6013 all-position electrodes are employed for all subsequent deposits. The palm plates are welded to the struts at the shipyards since this work must be done at the time of installation owing to the fact that the wooden hulls to which the palm plates are to be affixed vary somewhat in contour.

This manufacturer's resourcefulness in the application of flame-cutting enables his delivery deadlines to be met on time whereas he would certainly have fallen way behind schedule had be been forced to delay for machining. Naturally, flame-cutting cannot substitute for every use of cutting tool. The experience of F. J. Valentine, however, suggests that the number of operations for which flame-cutting can substitute is perhaps much greater than is generally thought possible. There appears to exist a fertile field for research along this line.

* * *

Acknowledgment is made to Air Reduction Sales Co. for the three photographs and drawing reproduced herewith.

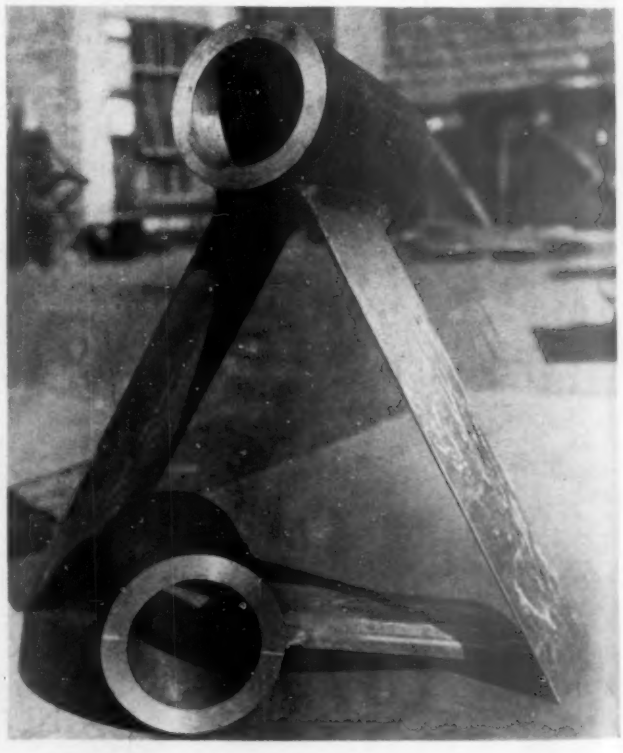

Fig. 4—Finished propeller shaft support showing how the struts are welded to the heavy pipe length containing the bearing. Note the effectiveness of the flame-machining. Palm plates will be welded to the ends of each strut at the shipyards, during the time of installation.

HELPING TO SOLVE TODAY'S WARTIME PRODUCTION PROBLEMS

Heavy structural parts on big bombers are now being SPOT WELDED!

...ON THE WORLD'S LARGEST SPOT WELDER

TH.S HUGE MACHINE, weighing nearly 19 tons, is successfully accomplishing one of the most difficult of welding processes: that of spot welding aluminum and other light alloys in the heavier gauges. Aircraft manufacturers are taking advantage of this development by speeding the fabrication of beams and other heavy structures. In some cases, this process is even efficiently replacing extruded structures.

The 240 KW machine illustrated (Type PMCO.5S-1) operates on the electro-magnetic Stored Energy Principle and incorporates the Sciaky Variable Pressure Cycle. Capacity for aluminum and other light alloys or corrosion resisting steels is thicknesses of from .040" plus .040" minimum up to and including .187" plus .187" maximum. This machine is capable of welding 40 spot welds per minute on two thicknesses of .040" light alloys. Maximum pressure, when both cylinders are operated at constant, 12,000 lbs.

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New A-C Welding Circuit

Higher arc-striking voltages at low currents, lower voltages with high currents are advantages claimed for an A-C welder that uses magnetic flux to induce a secondary reactor voltage.

By **G. C. QUINN**

Welding Engineer, Electrical Dept., Allis-Chalmers Mfg. Co.

FOR the past several years, almost continuous progress has been made in the field of A-C welding. The war, of course, has multiplied both the applications and the users of A-C welding tremendously. The important inherent advantages of A-C welders—freedom from arc blow, higher welding speeds, higher efficiency, virtual elimination of maintenance, quicker delivery and lower initial cost—have all played their parts in industry's wartime acceptance.

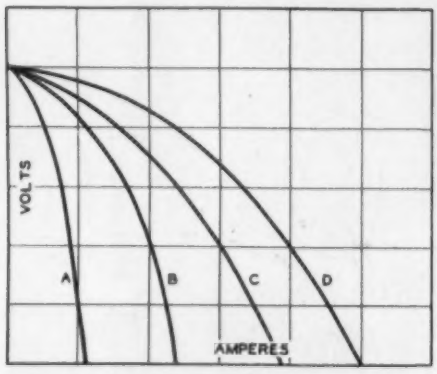


Fig. 1—Volt-ampere characteristic curves of today's average continuously variable A-C welder.

Improved Products

Electrode manufacturers are contributing regularly to the successful wartime application of A-C welding. The last two years have seen the perfection of acceptable A-C electrodes, and in particular those needed to meet the specifications of the AWS E-6011 class for vertical and overhead welding. To date, at least five makes of electrodes that meet this requirement are available, and others will undoubtedly follow.

Another important step is the establishment (contemplated for the near future by at least one stainless electrode manufacturer) of a complete line of "universal" stainless electrodes for use with either D-C or A-C welding equipment.

Welders, too, have been improved, and there can be no doubt but that the pace of progress in A-C welding is being well kept by the makers of the various welding units now on the market. An example of one improvement is a new A-C welder design that makes welding easier at lower currents and also improves operating economy when higher welding currents are used.

An A-C welder of the improved type described in the text tack welding heavy steel in a large tank and plate shop. Small A-C welders can oftentimes be used to advantage on work of this nature, releasing larger size welders for heavy-duty work.

In general, A-C welders differ widely in design, characteristics, weight, size and appearance. All transformer-type welders have in common, however, separate primary and secondary windings, operation from standard line voltage (usually 220 to 440 volts, single phase), a secondary voltage of from 50 to 100 volts, and some manner of provision for varying the welding current.

Constant vs. Variable Voltage

The electrical circuits of most continuously variable welders provide for a constant open circuit voltage (see Fig. 1). If any variation in voltage does occur, it is found to drop off as the current setting is decreased. Thus it is more difficult to strike an arc at lower currents, even with good A-C electrodes.

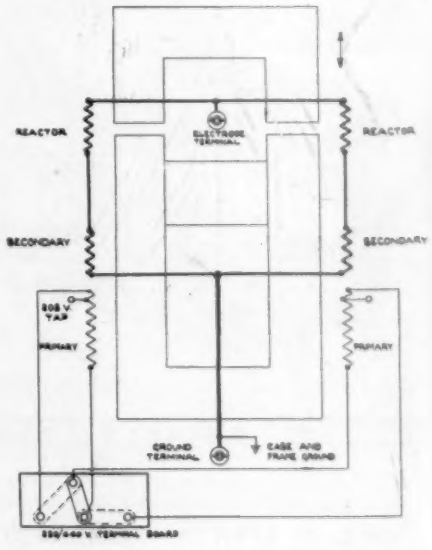
On the other hand, a much lower value of voltage than is normally employed can be used satisfactorily with higher currents, and any reduction in the open circuit voltage at high current settings would inevitably result in an improved power factor and a decreased kva input.

To enable the open circuit voltage of the welder to be varied to give the benefits outlined above, an electrical circuit was designed that combines transformer and reactor in the integrated core arrangement shown in Fig. 2. The lower part of the transformer proper consists of a coil-type transformer with two primary and secondary coils. That part of the core bridging across the center of the welder is common to both the reactor and transformer. The reactor coils above, connected in parallel, are wired in series with the secondary windings of the transformer.

Reactor Voltage

In operation, the upper U-shaped core can be moved up and down approximately 1 in. to control the welding current. When the core is in the closed position, the magnetic flux of the transformer has two paths to follow in crossing the upper part of the welder. Part of this flux passes through the U-shaped core and in

Fig. 2—Magnetic and electrical circuit of the new design. Part of the transformer's magnetic flux passes through the upper U-shaped core and induces a voltage in the reactor coils.



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AND IS Immediately Available!

Industry, today, is brazing many parts which were formerly drawn, cast, machined or forged—for brazing is producing important savings not only in men, materials and machines, but also in money and minutes.

For example, if you are now machining parts out of brass, bronze or copper, in many cases you can do the job faster and better by changing over to stampings that can be assembled and brazed. Or, if you are now brazing nonferrous metal parts with high temperature, hard-to-handle alloys or expensive silver solders, specify Westinghouse Phos-Copper and you will reduce rejects, speed output and cut manufacturing costs.

Brazing with Phos-Copper is *fast*. It flows free and smooth at 1382° F., cutting application and assembly time to the bone. And in many applications, Phos-Copper is successfully replacing hard-to-get tin solders.

With any brazing method, you will save time, money, materials, and get sounder, tighter joints with Phos-Copper, and . . . it's immediately available. Ask your Westinghouse Office for a sample for an on-the-job test.

NEW PHOS-COPPER BOOKLET. Get your copy of the new Westinghouse brazing bulletin B-3201. It explains ways to braze, how to make good brazes, proper joint design, and gives complete application photographs and details about Phos-Copper. Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., Dept. 7-N. J-91035

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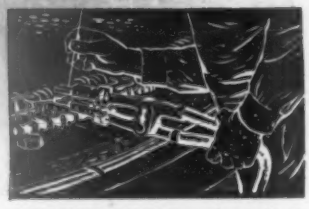

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ROD: Ideal for face-feeding—particularly where torches are used. Sizes: $\frac{1}{16}$" to $\frac{1}{4}$"—36" long. Small sizes are excellent for joining small parts.

RIBBON: Used especially for inserts. Comes .015" thick by 1.25" wide in various lengths. Approximately 16 feet per pound.

SPECIAL SHAPES: Popular for "tong" and furnace brazing. Preplacement of Phos-Copper makes mass production brazing possible and economical. Rings, strips, thin ribbon, diameters smaller than $\frac{1}{16}$", etc., can be supplied for special applications.

*Phos-Copper is an alloy of phosphorus and copper used for brazing copper, brass or bronze joints.

doing so induces a voltage (from 5 to 15 v, depending on welder size) into the reactor coils. Since each reactor coil is connected in series with the secondary directly below, it becomes, in effect, part of the secondary winding, thus increasing the open-circuit voltage (see Fig. 2).

With the air gap closed, impedance of the reactor coils is at a maximum, and a minimum of welding current can flow. However, the open circuit striking voltage is at its highest, giving the best possible welding characteristic for small rods. This corresponds to Curve A of Fig. 3.

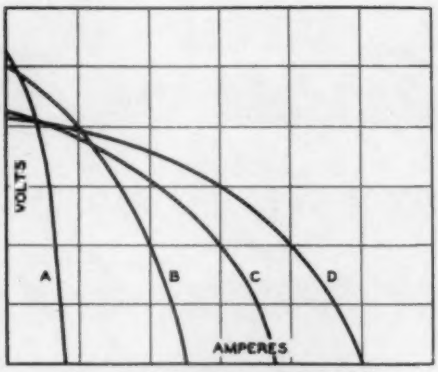

Fig. 3—Volt-ampere characteristic curves showing effect of the new design on open circuit voltage.

As the upper core is raised, less and less flux passes through the upper core at no load, resulting in a corresponding drop in open circuit voltage. These points correspond to Curves B, C and D of Fig. 3. At full load operation (Curve D), the voltage induced in the reactor coils is negligible, and the striking voltage has dropped to that produced by the secondary coils.

Thus we have a new and different electrical circuit, producing the welding characteristics needed to keep pace with today's requirements in A-C welding.

★ ★ ★

Preheating Avoids Cracks

Photomicrographs disprove common misconception that plain carbon steels can always be welded safely without preheat.

PLAIN carbon steels containing up to 0.35% carbon are probably as easily and as satisfactorily welded as any known metal or alloy. For this reason, perhaps, there has arisen the common misconception that low or medium carbon steels can be satisfactorily welded under any and all conditions without preheating. However, engineers and metallurgists have learned from experience, this is not always true. Preheating is an important insurance factor if cracks are to be avoided.

The higher the carbon content, the harder the steel becomes after welding—both in the weld and in the adjacent heat-affected zone. This obviously lessens the ductility of the weld-metal and correspondingly increases the danger of cracking. Manganese also exerts a hardening influence similar to that of carbon; roughly, manganese is 1/7 as potent as carbon in this respect. In addition to manganese and carbon, any plain carbon steel may also happen to contain accidental alloying elements which will increase its hardening tendencies.

Bear in mind, too, that the more rapid the rate of cooling, the greater the risk of crack formation. Some of the factors which increase the danger of cracking by favoring rapid cooling are: a rapid rate of welding, a small electrode diameter, a small welding area in a relatively large mass of adjacent metal, a low atmospheric temperature. With regard to the last, preheating, though at all times highly desirable as a means of minimizing the cooling factors, becomes a "must" precaution in cold weather for the welding of all steels.

Figs. 1 and 2 are photomicrographs which illustrate the effect of a slight preheat—at 200 F—in eliminating cracks. The steel had a content of 0.20% carbon and 0.65% manganese, which places it definitely in the category of low carbon steel. The sections were 1½ in. thick.

By all the rules, this steel should be an extremely easy substance to weld, and a great many welding fabricators would hold that preheating of the sections would not be necessary. Nevertheless, micro-cracks appeared, Fig. 1, after welding without preheat and using ¼ in. electrodes.

Fig. 2 shows the improved result obtained after preheating with a gas torch at 200 F. The structure is now homogeneous, and there are no cracks.

To control preheating temperature, the plate was marked with a temperature-indicating crayon liquefying at 200 F. When that temperature was reached, the crayon mark melted to a liquid smear, signaling to the operator that it was time to begin welding. The state of the smear was watched during welding; whenever it solidified, signaling that the temperature had dropped below 200 F, more heat was applied.

* * *

Acknowledgment is made to the Tempil Corp., New York City, for the two photomicrographs reproduced herewith.

Fig. 1—Note the micro-cracks in this photomicrograph of a welded section of low carbon steel (0.20% carbon, 0.65% manganese). Section was not preheated.

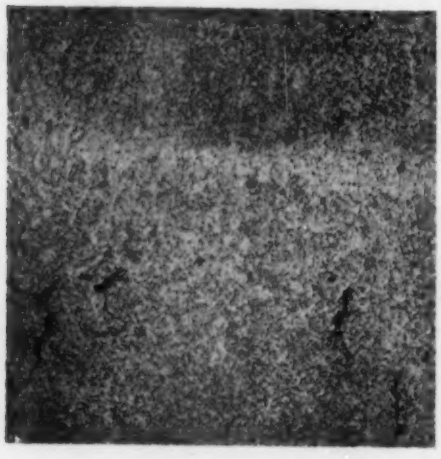

Fig. 2—Note the homogeneous structure of this welded section of the same material shown in the section pictured in Fig. 1. This section was preheated at 200 F.

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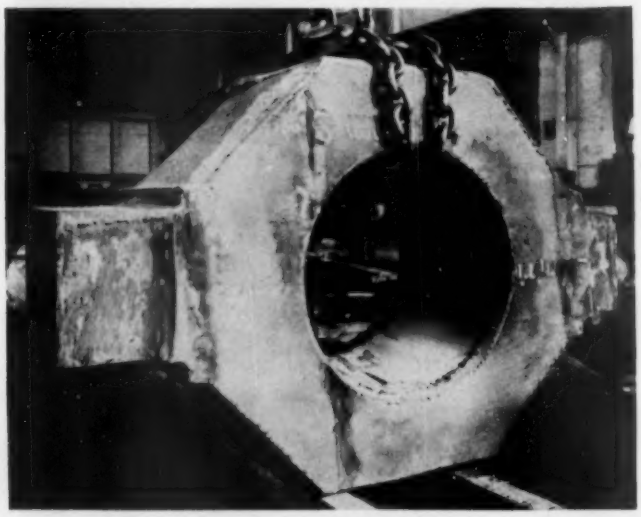
On the Job

Cutting a Seven-Ton Slab

FLAME-CUTTING a steel slab 20 in. thick with a machine having a smaller cutting range than the size of the work piece constitutes a major achievement—and a triumph for the flexibility of the flame-cutting process.

The big job was done at a Montreal structural steel plant, employing a planograph-type cutting machine with a tip having a cutting-oxygen orifice of 0.332 in. diam. The mammoth crosshead shown in the picture is 42 by 65 in. while the normal cutting range of the machine is but 24 by 72 in. Obviously, the slab (which weighed seven tons) had to be cut in installments. It was repositioned several times during the cutting in order to bring first one end, then the other end, and then the central position, into the motion range of the cutting torch.



Flame-cut crosshead, 20 in. thick. It is shown here after annealing and before removal of furnace scale and machining.

Courtesy, Air Reduction Sales Co.

The cutting was done with a water-cooled torch after the slab had been preheated to 400 F. An oxygen pressure of 40 psi was used, and a cutting speed of 3 in. per min was attained. All cuts, it should be noted, were made on the full 20 in. thickness. The crosshead was annealed after cutting and then finish-machined.

The total time for setting up and cutting was only three hours as compared to the at least two weeks of rough machining which would have been required had the slab been shaped by this method.

» «

Welded Musical Instruments

FABRICATION of the first all-welded aluminum guitar and mandolin is the unique claim of Victor D. Thomas, a weldor war worker at the Twin Coach Co., Kent, Ohio. Mr. Thomas has designed and made several of these instruments in his spare time.

The main advantage of the aluminum guitar and mandolin, Thomas says, is that they will not warp and hence will maintain tones much more accurately than similar wooden instruments, which are affected by changes in humidity and weather.

Courtesy, The Lincoln Electric Co.

Instrument builder Victor Thomas picks out a tune on his welded mandolin. A welded aluminum guitar of similar design is in the foreground.

One of the outstanding guitar players of the country tried out the welded guitar and declared that it was one of the finest instruments he had ever played.

Both the mandolin and guitar are constructed of light gauge aluminum sheet. The component parts are welded at the joints with a 5% silicon-aluminum alloy shielded arc electrode, 3/32 in. size, that is specially made for arc welding aluminum. The tops of the instruments have a double curvature—found only in very expensive mandolins and guitars made of wood. This gives the superior resonating quality found in high quality guitars and mandolins of the conventional type.

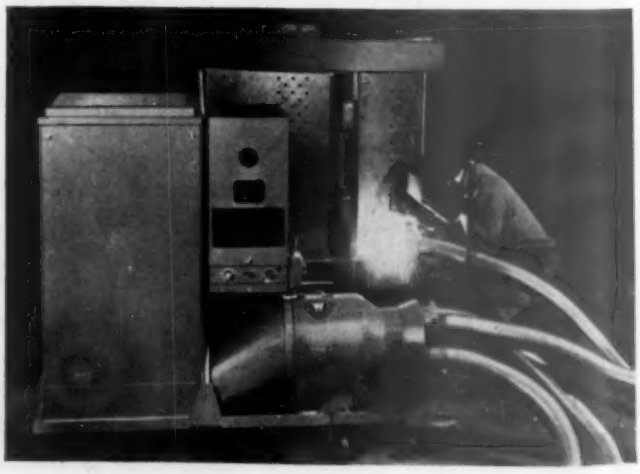
The fingerboard is made of a ¼ in. aluminum bar. Copper-alloy frets were inserted in saw cuts in the side of the bar, caulked and welded. The bottom corners of the frets were filed off before insertion so that the copper alloy would not be melted by the electric arc and interfere with the weld made in joining the two portions of the fingerboard. The parts comprising the main sound box of the instrument were tack welded in place all around the joints, then skip welded in order to avoid distortion.

Mr. Thomas had never been musically inclined before he started to make musical instruments, but he had to become proficient in playing both guitar and mandolin in order to make sure that his welded instruments had the proper tone qualities and were easy to play.

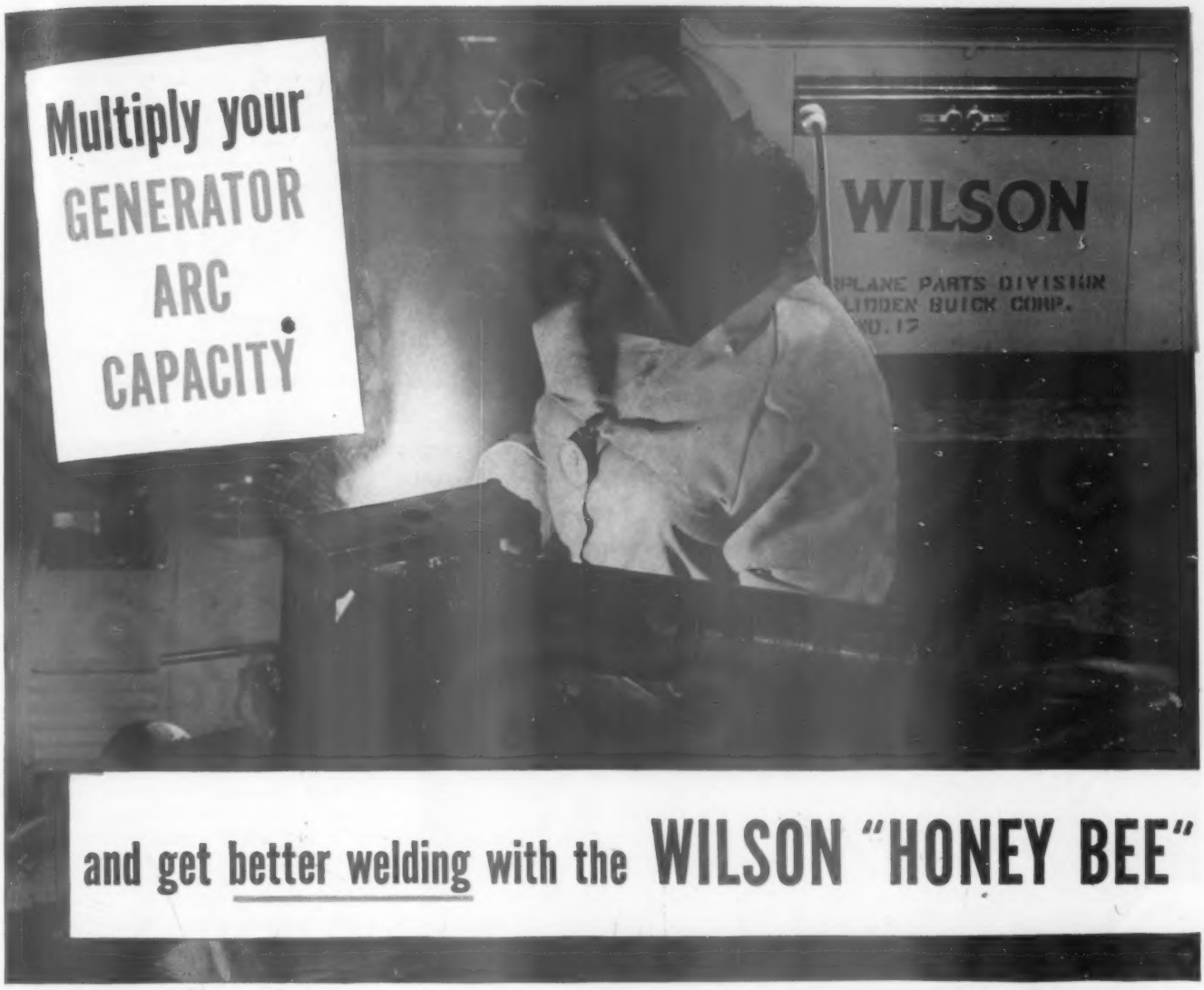
» «

Welding Fume Remover

ONE of the latest uses of electronics is for the removal of welding fumes. These fumes, like smoke of all kinds, consist of clouds of minute air-borne particles, some of which may be as small as 1/250,000 of an inch. The portable Westinghouse "Precipitron" shown in the accompanying picture contains electronic tubes which create a strong electrostatic field that charges every particle of dust-bearing air entering the unit. The charged particles are then drawn irresistibly to oppositely charged plates and precipitated thereon. Cleansed of 90% of the fumes and dust particles of all kinds, the air is then returned to the welding shop.



Electrostatic air cleaning unit with three flexible metal hoses for the removal of welding fumes. It can be moved to any location where welding is going on.



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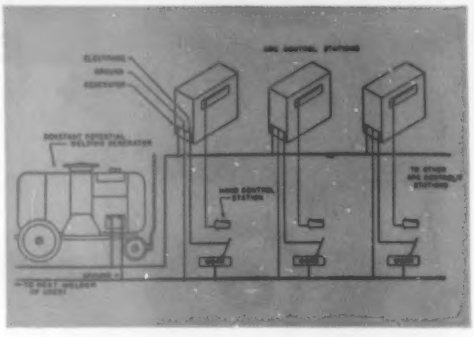
Connecting a number of Wilson "Honey Bee" arc control stations to any constant potential generator, gives you two timely advantages:

1. By providing more arcs per generator, it permits an increase in the number of welding operations that can be performed simultaneously from a single generator.

2. It assures better quality welds – especially on light-gauge metal – through the "Honey Bee's" Remote Arc and Crater Control.

Each operator using a "Honey Bee" station holds a remote arc control switch by which he may regulate his current (from zero to maximum) while welding – *without first extinguishing the arc.* Only the Wilson "Honey Bee" provides this valuable advantage. In addition, the "Honey Bee's" Remote Crater Control permits the operator to fade out the arc slowly – never abruptly – to prevent crater cracks, porosity and similar weld defects.

The Wilson "Honey Bee" is available in 75 amp. and 150 amp. sizes. For further details get in touch with your nearest Air Reduction office. A descriptive bulletin ADW-47 will be forwarded on request.



*Two or more Wilson "Honey Bee" stations may be connected in series to any constant potential generator. Most welding generators can be changed to constant potential by a simple wiring change. The welding current available to each station operator is determined by the number of "Honey Bee" stations used and the capacity of the welding generator.

Photograph courtesy Glidden-Buick Corp., New York

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Welding Oxygen Cylinders

AUTOMATIC atomic-hydrogen arc welding is being used by the Chambers Corp., Shelbyville, Ind., to speed the fabrication of oxygen cylinders for the U. S. armed forces. An electronically controlled 75 amp welding head is used to seal the seams without the use of filler rod.

The cylinders are formed by rolling alloy steel sheets approximately 0.043 in. thick into tubes. The butting edges are turned up in a slight burr and are then fused together by being passed under the head of the automatic atomic-hydrogen seam welder. The slight burr facilitates the welding process and improves the quality of the finished product.

The same 75 amp machine is used to weld the hemispherical ends onto the cylinders. In this operation, the work automatically revolves under the welding head once the ends have been fastened in the cylinders. The finished cylinders are tested under hydrostatic pressure of up to 1,000 psi and checked for leaks with air under high pressure.

Courtesy General Electric Co.

Automatic atomic-hydrogen welding of oxygen cylinders. The operator is adjusting the control on the welding head preparatory to starting welding of the cylinder seams.

» «

Normalizing on Welder

By LUCIUS S. FLINT

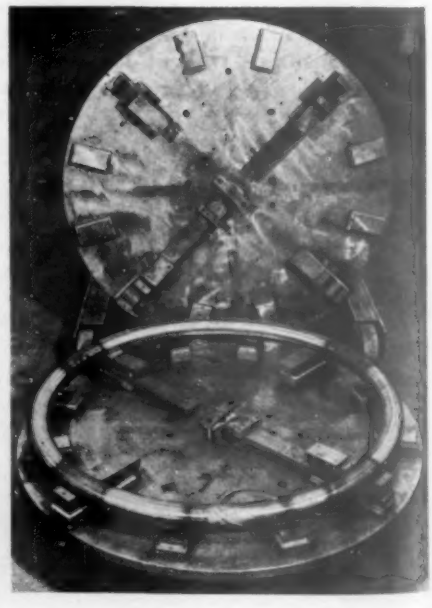
A SPECIAL fixture for normalizing motor mount rings on a 400 kva projection welding machine has been developed by the tool engineering department of the Vega Aircraft Corp.

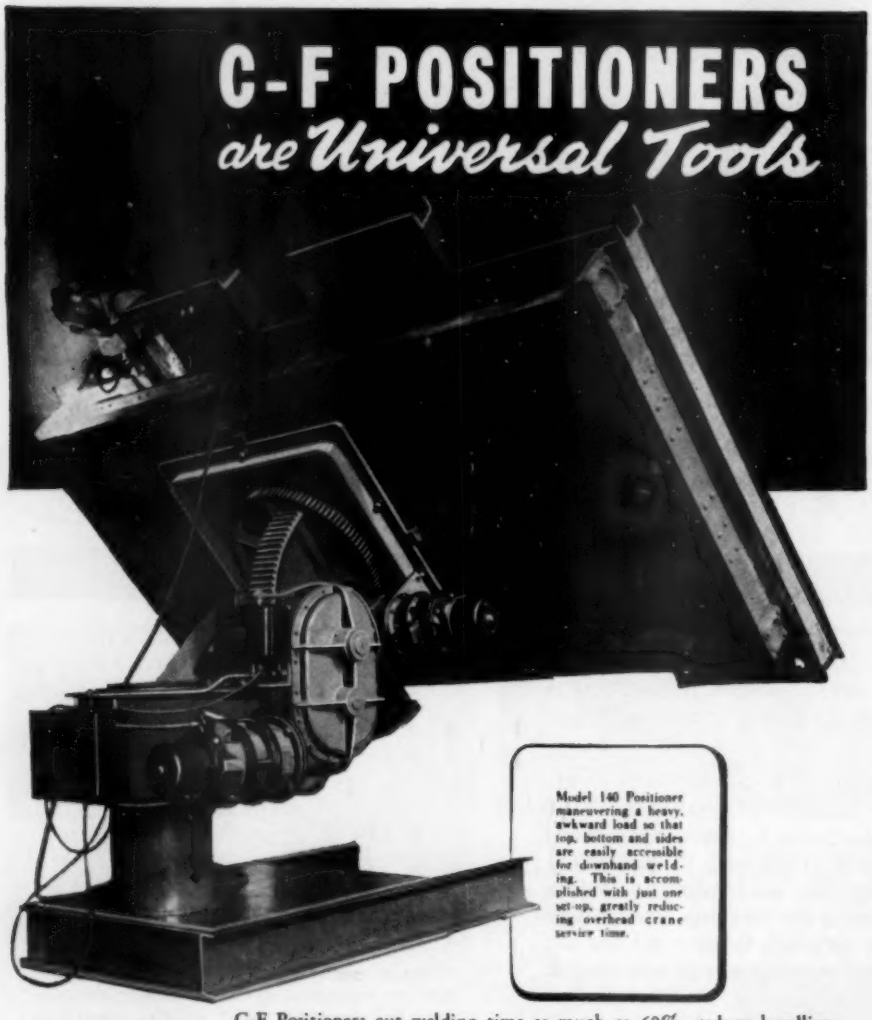
Normalizing, undertaken to produce a refined grain structure, consists of heating the metal 100 F or so above its critical point and allowing it to cool naturally in still air. With the new Vega system, the heating-cooling cycle is accomplished in approximately fifty seconds. Formerly, more than thirty minutes were required.

Four full-floating electrode clamps, spaced equally at 90 deg, distribute the high amperage, low voltage current which heats the four quadrants of the ring equally and simultaneously. After the motor mount ring has been clamped in place, the entire fixture is clamped to the upper and lower platens of the projection welder. An electronic timer provides a "pulsation" current in the manner most conducive to proper dissipation of heat from the electrode contacts.

Since the projection welding machine is able to exert a pressure of five tons or more between its platens, hot straightening of the rings could be accomplished simply by providing suitable clamps.

Motor mount ring in position on special fixture that was developed at Vega Aircraft for normalizing with a projection welder.

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are Universal Tools
Model 140 Positioner maneuvering a heavy, awkward load so that top, bottom and sides are easily accessible for downhand welding. This is accomplished with just one set-up, greatly reducing overhead crane service time.

Write for Bulletin WP 22.

C-F Positioners cut welding time as much as 60%, reduce handling time to a fraction, assure uniformly stronger, smoother welds, and greatly increase output per man.

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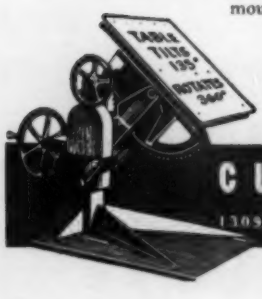

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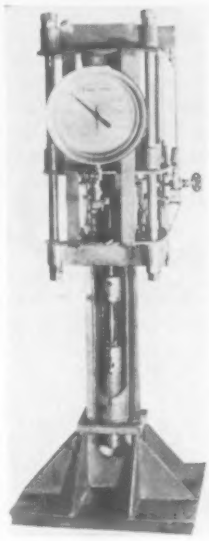
1309 SOUTH KILBOURN AVENUE CHICAGO, ILLINOIS

Tensile Testing Machine

WELDORS weld a tensile testing machine for testing welds. No, that sentence isn't a tongue twister like Peter's pickled peppers, but a statement of what actually did occur at Piper Aircraft Corp. when Harry J. Shea, division head of the tool and die department, and Ralph C. Rathbun, head of welding quality control, got together and designed an all-welded tensile testing machine.



Courtesy, Hobart Bros.

This welded tensile testing machine was made at a cost of $500. A specimen can be seen gripped in the jaws.

Welded fabrication, according to Mr. Shea, not only effected material savings but also put the machine in operation several weeks earlier than it would have been operating if castings had been used.

This machine is used for testing welds in both flat stock and tubing in giving Army-Navy tests to weldors. It may also be utilized for testing bends and for shear tests by using the top plate above the upper screw.

The pressure is furnished by four eight-ton hydraulic jacks connected to one hydraulic pump located on the right side of the machine. Connected to the hydraulic line is a gauge which registers both psi and total load pounds. A ball seat in the hydraulic line leading to the gauge holds the pressure until a reading can be taken and also serves to relieve the sudden jar that occurs when the specimen breaks. The pressure on the gauge can be relieved by opening a valve in a by-pass around the seat.

» «

Welding Big Pipe

SOMETHING like 1,400 miles of 24 in. seamless pipe of ⅜ in. wall thickness had to be welded in the construction of the "Big Inch," the world's largest oil pipe line. Special techniques had to be developed to speed up completion so that badly needed oil might be brought to the east coast despite the shortage of shipping facilities.

The picture shows one important phase in construction: the line-up and tacking of the big pipe sections. The pipes, mounted on dollies, are seen here as they were lined up, clamped and tack welded.

The firing line roll weldors completed the job of the tackers and joined three lengths of pipe into one section. The first pass was made with a 3/16 in. all-position mild steel electrode, using 200 amp. The second pass was made with a ¼ in. electrode of the same type, using 325 amp. and the third pass with a 5/16 in. electrode, using 375 to 400 amp. Each roll weldor marked his welds with a stencil prior to inspection and was compelled to reweld any imperfections before he left that section of the pipe.

» «

Fabricating Big Gears

"IN ORDER to save material, the rims and webs of our 6 ft gears are welded up from sections," writes Weldor Edward Schoop. "This not only saves material by using pieces which might otherwise lie idle but also saves time by not having to wait for the full size stuff, which is not always so easy to get these days.

Courtesy, Harnischfeger Corp.

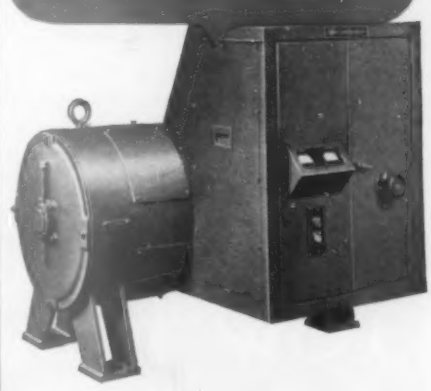
Welding up sections to make 6 ft gears.

"The rims have a face of 8½ by 1¾ in. and are of 1040 steel. The hub is hogged out of 9 in. round 1035 stock, and the web sections are structural steel. On the deep seams of the rim, we use a low alloy electrode developed for stainless steel repair applications, and on the circular seams we double pass with E-6010 (all-position) 5/16 in. electrodes. The welders are set at 300 amp."

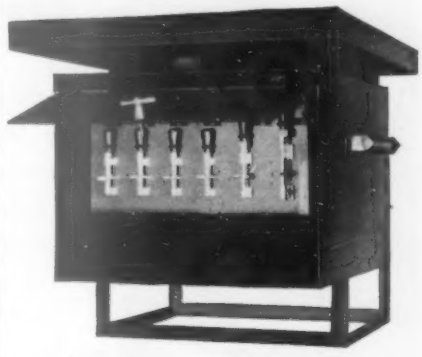
Line-up and tacking crews of the firing line gang as they speed construction of the "Big Inch."

Courtesy, The Lincoln Electric Co.

ONE MULTIPLE-OPERATOR SET DOES THE WORK OF 20 TO 30 SINGLE-OPERATOR SETS



For continuous-duty, mass production welding where a large number of operators can work in a small area, specify Westinghouse Constant-Potential Multiple-Operator Sets. Welding control panels can be assembled in banks or used singly. Operating power factor, where synchronous motor drives are used, will average 80% leading. Over-all efficiency is 45%.



Operator control panels are available in single and two-operator types. Current range is 150, 200, 250 and 300 amperes. Same range for each operator on two-operator types. Dripproof enclosures. For latest literature, write to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-90477

Westinghouse

WELDERS

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Do You Agree?

Welding Malleable Iron

Q—Is it possible to weld malleable iron? We have attempted to weld this material with many different types of welding rods but the weld fails to hold or else it burns and is no good. What is our trouble?—*K.A.P.*

A—Strictly speaking, malleable iron cannot be satisfactorily *welded*, but it can be *brazed*, using a bronze rod. A malleable iron casting should be heated only to a red heat and never to the melting point. This degree of heat does not affect the malleability of the casting nearly so much as does a melting temperature, and, furthermore, a comparatively strong repair can be made. If the bronze is built up so as to produce a reinforcement in the weld area, the joint will be even stronger than the original casting.

The failure of your previous efforts is undoubtedly due to improper brazing technique. Either a neutral or a very slightly carburizing flame should be used to heat the casting to a dull red heat. The temperature of a medium red heat is around 1,300 F, and it is necessary to remember that manganese bronze, which is often used for this work, melts at 1,600 F and will burn at a little over 1,700 F. The most important part of the process is to keep the bronze from burning; this is done by drawing the torch away from the weld at the moment it becomes too hot.

Care should also be taken to see that the proper flux is used. The flux used for brazing malleable iron castings differs from that used on gray iron castings.

» «

Hardening Cast Iron

Q—Can gray cast iron be flame-hardened? What temperature should you have the cast iron before it is quenched? Also, is it advisable to quench a very large casting?—*O.C.P.*

A—Gray cast iron may be flame-hardened quite readily. Any cast iron can be satisfactorily flame-hardened provided that its combined carbon content falls between the range of 0.50% to 0.80%. Below a combined carbon content of 0.50% maximum hardness cannot be developed, and above 0.80% the cast iron is liable to crack.

The quenching temperature in flame-hardening depends upon the depth of hardness desired. Usually a temperature of around 1,400 F will produce satisfactory hardness. If greater hardness depth is desired, the heat must penetrate to a greater distance, and, consequently, a higher surface temperature must be obtained.

In flame-hardening large cast iron objects, only a small area is heated at one time, and there is, consequently, little likelihood of warpage. Hence little difficulty should be experienced in quenching large objects.

» «

He Didn't Agree!

L. Pellegrin, director of research and production, Shober Sales, Inc., Stockton, Calif., did not wholly agree with our answer on welding electrode coatings (see page 60, THE WELDING ENGINEER, August, 1943). He writes in part:

"I fully agree with you on the cellulosic type of electrodes regarding the constituents used, but I find it impossible to agree with you that this type of electrode is used on D-C reverse polarity only, since we, as well as others, have developed high cellulosic electrodes which will function on D-C reverse polarity as well as on A-C in all positions.

"The common conception has been that A-C electrodes would function on D-C straight polarity only, but this has been changed somewhat in the past year."

* * *

The editors are investigating this subject more fully and will let you know in an early issue what other authorities think.

If you, as a reader, do not agree with our answers, let us know your thoughts. Your comments and discussions will be published, too.

Castolin Eutectic

EUTECTIC

(Means Lowest Binding Alloy)

LOW TEMPERATURE WELDING

Salvaging form tools broken through dovetail section. Low frictional coefficient. Machinable. Eutectic Alloy No. 185

NEW, EASY METHOD FOR

TOOL SALVAGING

Daily, more and more prominent war plants turn to Eutectic Low Temperature Welding Alloys for fast, simplified, economical reclamation of "hard-to-get" production tools.

One plant reports salvaging, in but a few minutes at a cost of but a few cents, a tool costing $180. Tools requiring up to 50 weeks for delivery are put back in use in but a few minutes.

Milling cutter salvaged with Eutectic Alloy No. 16

★

Only "Eutectic* Alloys" are the true Low Temperature Welding Alloys that are revolutionizing production welding, maintenance welding and salvaging in war plants throughout the nation. There are 42 specialized rods for every metal and every welding job. Developed and manufactured only by Eutectic Welding Alloys Company.

* Reg. U. S. Pat. Off.

Tipping with tungsten carbide or stellite. No recessing of shank necessary, Eutectic Alloy No. 16.

★

FREE LATEST TOOL SALVAGE POSTER K

Gives complete instructions for salvaging these and other war production tools. Write today!

EUTECTIC

WELDING ALLOYS COMPANY

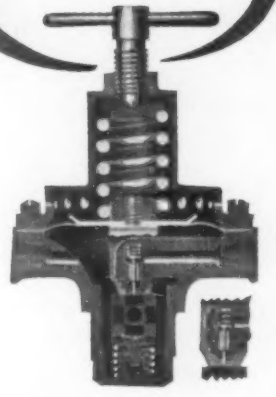
SOLE MANUFACTURER - CASTOLIN EUTECTIC WELDING ALLOYS

40 WORTH STREET, NEW YORK, 13, N.Y.

MECO Safe-T-Chek Regulators Are in Action Everywhere

☆ Millions of tons of cargo ships — millions of tons of battle ships

. . . owe much of their speed of production to oxygen. After the ship is launched — oxygen continues to play a vital role in the operation and maintenance of these guardians of our freedom. ☆ *And* . . . the guardians of the vital oxygen in thousands of cases — in yards and on the sea are Meco Safe-T-Chek Regulators — safe, reliable and efficient in performance.



☆ The Meco Safe-T-Chek Regulator showing the Meco Safe-T-Chek Valve in the high pressure inlet. This valve remains in closed position until the regulator diaphragm goes into operation.

Meco

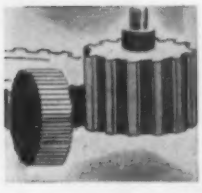
WELDING AND CUTTING EQUIPMENT

MODERN ENGINEERING CO.

3413 PINE BOULEVARD ST. LOUIS, MISSOURI

. . . with **X-RAY**

—the modern way to check internal clearances



It's easy to make sure that mesh and clearances between gears and housing of completed mechanical assemblies are "right"... look inside with Westinghouse X-ray. Inspection of completed tab gear boxes for fighter planes is one of many unusual jobs where Westinghouse X-ray saves time in the plant . . . lives and equipment on the front. J-02016

More dope? *See Page 18*

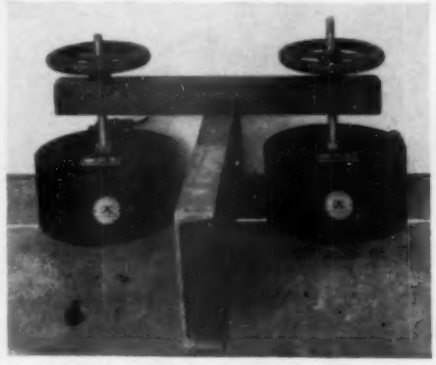
Westinghouse X-RAY

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

New Products to Use

Magnetic Clamps

★ **Hercules Magnetic Aligners** were designed for shipbuilding (and for other work in which extensive welding of heavy plate is required) to replace the slower practices of welding on temporary clamps, wedging, using heavy weights, etc. Operation is quick, simple, foolproof, states manufacturer, and the magnetic pull is so great that men can work nearby without disturbing the alignment. Each aligner has a surface pull of one ton on a 1 in. plate.



Magnetic aligners. Warped plates are quickly positioned for welding to a stiffener beam by placing two aligners as pictured here. Buckling eliminated by the powerful pressure.

The accompanying illustration shows two of these clamps being used to hold warped plates to a stiffener beam for welding. (Shipbuilding requires reinforced stiffener beams welded across each plate at stated intervals). By turning the wheels, 4,000 lb pressure can be applied through the crossbar to the stiffener beam and plate, causing powerful adhesion and a perfect unwarped fit.

Standard aligners are for operation at 40 volts D-C; special models can be wound for 40-60 volt D-C welder-generators. A rectifier of this manufacture is available; it will operate one to four aligners on 220 volt A-C. **Hercules Electric & Mfg. Co., Inc.,** 2416 Atlantic Ave., Brooklyn.

» «

Metal Stamps

★ Government regulations require certification in connection with welds made on such products as aircraft, etc. To simplify compliance, a line of standard marking stamps has been announced by **New Method Steel Stamps, Inc.,** 147 Jos. Campau St., Detroit 7. These permit each weldor to be given an exclusive marking design so that his welds can be immediately identified.

Weld marking stamps. These permit compliance with Government regulations calling for the certification of each weldor and the assigning of an exclusive marking design to him.

The "registered weldor" stamps developed by New Method comprise only a numeral or letter enclosed within a border of simple shape such as a circle, ellipse, triangle or square. The system, however, is said to be sufficiently flexible to permit an individual stamp to be assigned to every weldor in a plant, no matter how many are employed. The stamps are available in border sizes ranging from ⅛ to ¼ in. All stamps have been specially heat treated to retard mushrooming, declares manufacturer.

» «

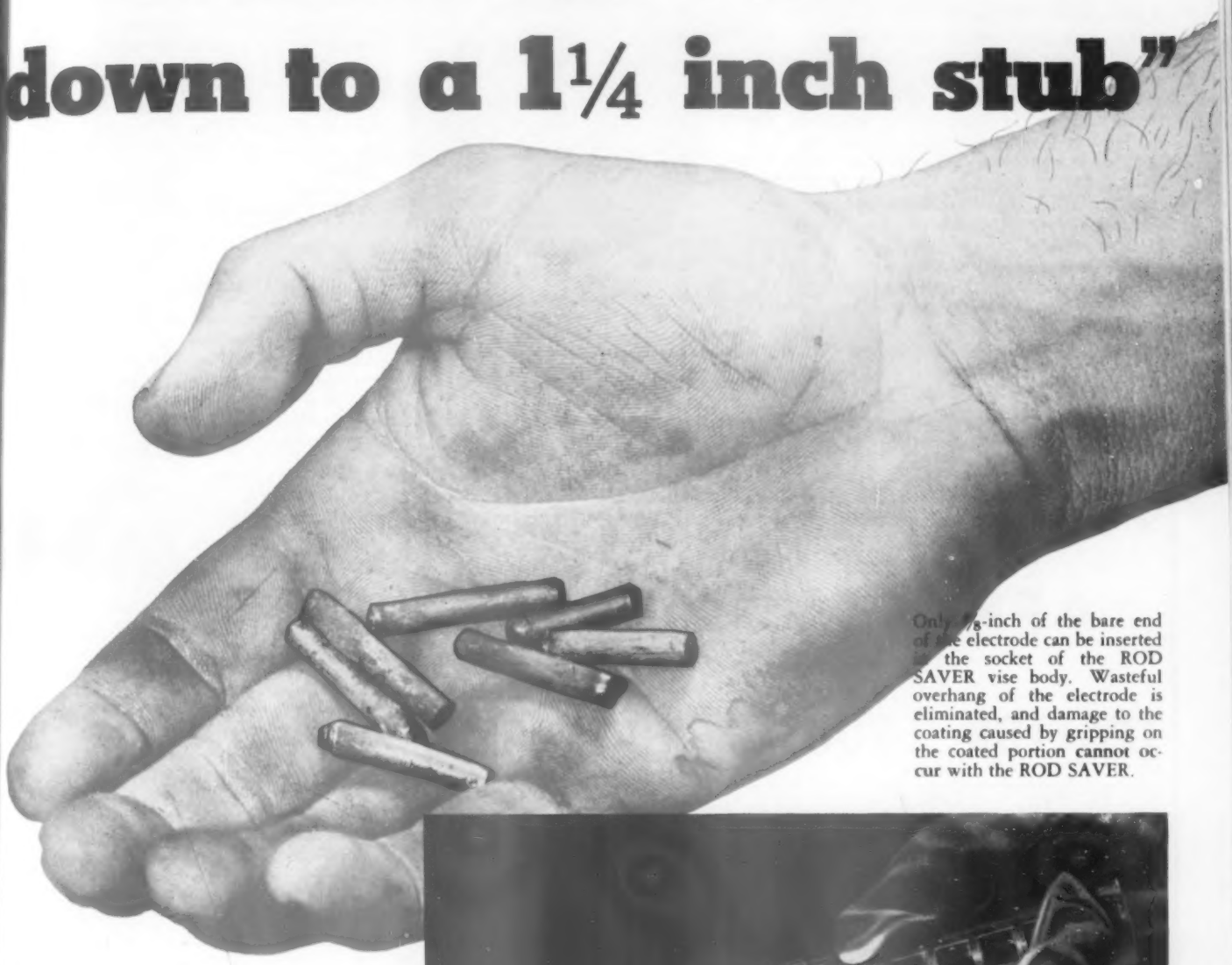
Plastic Safety Whistle

★ This regulation-size safety whistle has been accepted by the Maritime Commission for shipyards. It is made of one-piece plastic (available in black or ivory) and comes equipped with an extra durable naval-type cord. The large tone chamber and cork ball enable a loud, shrill tone to be produced with minimum effort, says manufacturer. **H. Apelt Importing and Trading Co.,** 155 John St., New York City.

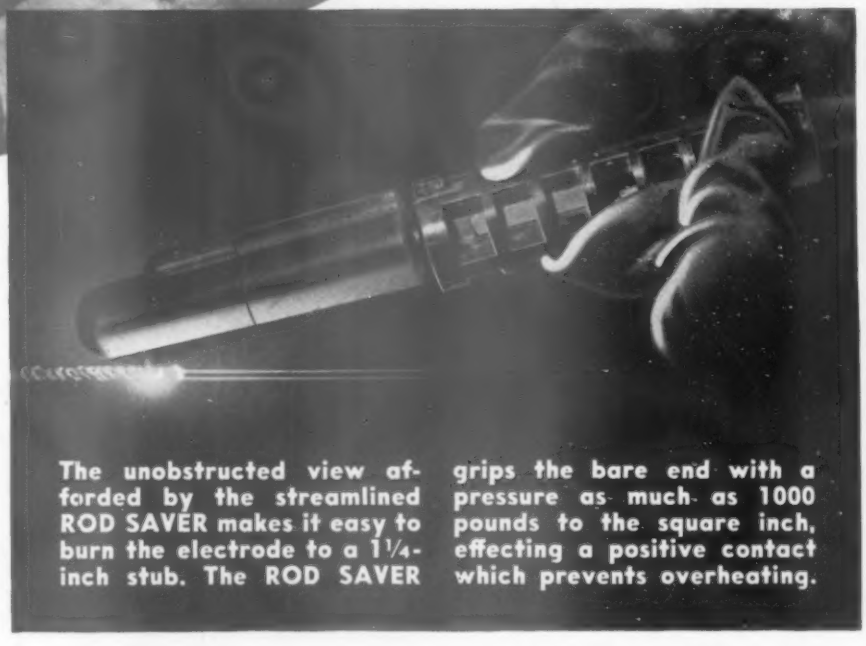
Safety whistle for war plants and shipyards. It is made of plastic to save metals.

ROD SAVERS BURN ELECTRODES

down to a 1¼ inch stub"



Only ⅜-inch of the bare end of the electrode can be inserted in the socket of the ROD SAVER vise body. Wasteful overhang of the electrode is eliminated, and damage to the coating caused by gripping on the coated portion cannot occur with the ROD SAVER.



The unobstructed view afforded by the streamlined ROD SAVER makes it easy to burn the electrode to a 1¼-inch stub. The ROD SAVER grips the bare end with a pressure as much as 1000 pounds to the square inch, effecting a positive contact which prevents overheating.

Save 7% to 14%
Of Electrode Consumption

With the new ROD SAVER the electrode can be burned to a 1¼-inch stub without overheating the holder or discomfort to the welder. Such savings of electrodes reach a staggering total when computed in terms of inches, feet, pounds and dollars, and may save 7% to 14% of your electrode costs.

Contact your dealer, or write direct to Martin Wells

Martin Wells

— MANUFACTURER —

"SUREGRIP" ROD SAVERS

5886 COMPTON AVENUE, LOS ANGELES 1, CALIFORNIA

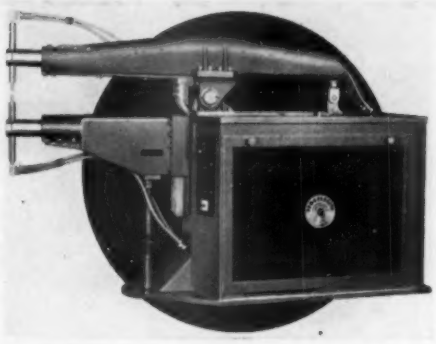
Aluminum Welder

★ Progressive **Model "B"** is an improved rocker arm spot welder specifically designed for the condenser-discharge welding of aluminum sheet. It will handle any combination of two thicknesses of 24-ST Alclad between 0.016 in. and 0.081 in. at production rates of between 1,000 and 2,000 spots per hr (including point dressing time).

Features of this machine include a throat which is adjustable in depth from 36 to 42 in. and a retractable upper arm which permits insertion of flanged work. The retraction is accomplished through a separate air cylinder controlled by an auxiliary foot-switch.

Standard equipment includes solenoid-operated valves for controlling the air-operated mechanism, air pressure gauges, air regulating valves, air line lubricator and dual-shrouded operator's treadle. Refrigerated electrodes may be installed at slight extra cost.

The transformer is rated for a maximum of 3,000 volts of capacitor charge but is tested to 6,000 volts. It is provided with a tap switch, permitting selection of several turn ratios. **Progressive Welder Co.**, Detroit 12, Mich.

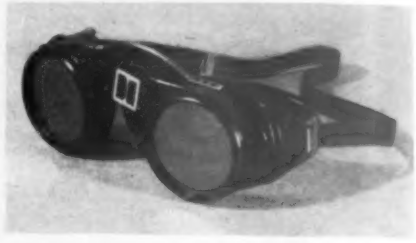


Model "B" rocker arm spot welder. It has passed all qualification tests, states manufacturer, and is now being used in the production welding of aircraft assemblies.

» «

Welding Goggles

★ Two new models of **"Coveralls"** have just been introduced by the **Metro Mfg. Co.**, 93-04 150th St., Jamaica, N. Y. The welding goggles shown in the accompanying illustration have black lenses to bar passage of harmful ultra-violet rays to the eyes. These goggles are also available with transparent lenses of shatterproof glass for chipping and grinding operations.



Metro "Coveralls." These are available with black lenses (as shown here) for welding or transparent lenses for chipping and grinding.

If desired, the transparent chipper goggles may be obtained with a green shade number two lens. This will provide eye-protection against flashes encountered from nearby welding operations.

» «

Spatter Preventive

★ **"Protect-O-Metal No. 2"** is a gray, creamy liquid said to have a pronounced fluxing effect while protecting work surfaces from spatter. The liquid is supplied in 1 and 5 gal cans, and it can be thinned with an equal part of water for average welding. The thinned compound is brushed or sprayed directly into the seam to be welded and on the surrounding surfaces where spatter usually collects. The compound in the seam is said to be active in removing oxides and other impurities from the weld and also to protect the weld from scale formation caused by oxidation when welding is interrupted. Another advantage claimed for the use of this compound is that it will quiet and stabilize the arc, thus permitting a greater welding speed.

After welding, the spatter and surface oxide may be quickly rubbed off with a damp cloth. This permits postweld clean-up time to be cut by as much as 90%, states manufacturer. **George W. Smith & Sons**, 79 South Sperling Ave., Dayton, Ohio.

(Please turn to page 73)

MANGANAL

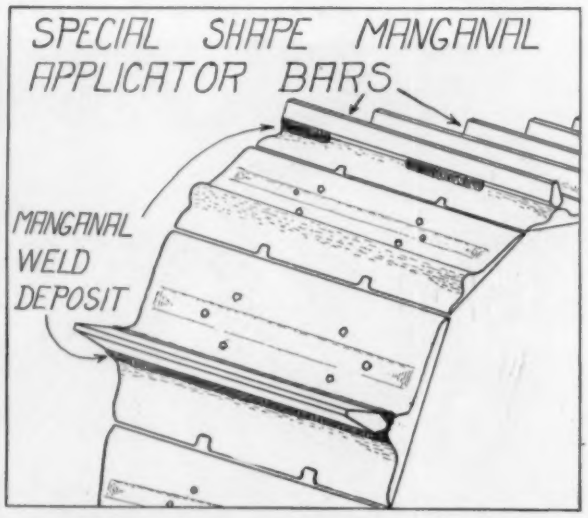
(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945)

SPECIAL SHAPE

APPLICATOR BARS

FOR

TRACTOR GROUSER RE-TREADS



MADE IN FIVE SIZES EASILY WELDED TO ANY SHAPE OR SIZE GROUSER. PROVIDES A RE-TREAD FOR ALL TRACK LAYING TYPES OF EQUIPMENT.

Attach with Manganal Bare or Special Tite Kote welding electrodes.

Applicator bars are manganese nickel steel, the toughest metal known. Work hardens under impact and abrasion.

New parts are difficult to obtain. Saves approximately 80% of the metal of a new part, as well as time and money.

150 Distributors Are Ready to Serve You

Sole Producers

STULZ-SICKLES COMPANY

134-142 Lafayette St., Newark, N. J.

Try Seaco Hard Surfacing Over Manganese Weld Deposits

Welding Rod Specifications

ALTHOUGH many users of gas welding rods are unaware of the fact, for the past year there has been in effect an AWS-ASTM Tentative Specification for iron and steel gas welding rods. This specification pertains to rods for the welding of carbon and low alloy steels of a weldable quality.

The welding rods covered by the specification are classified on the basis of the ultimate tensile strength of the deposited weld metal in the stress-relieved condition. The tensile strength requirements must equal those shown in Table I.

Table I. Tensile Requirements of Deposited Metal
(Using 3/16 or ¼ in. Welding Rods)

Welding Rod Classification Number	Plate Thickness, in.	Treatment of Welded Specimen[a]	Tension Test Requirements	
			Tensile Strength, min., psi.	Elongation in 2 in., min., per cent
GA65	¾	SR	65,000	20
		NSR	72,000	17
GA60	¾	SR	60,000	25
		NSR	62,000	20
GA50	¾	SR	50,000	28
		NSR	52,000	23
GB65	¾	SR	65,000	18
		NSR	72,000	15
GB60	¾	SR	60,000	20
		NSR	62,000	15
GB45	⅜	NSR	45,000[b]	..

[a]The abbreviations SR and NSR signify stress-relieved and non-stress-relieved, respectively. Stress-relieving when prescribed in these specifications is for the purpose of developing the fundamental properties of the weld metal unaltered by locked-up stresses. Values obtained from stress-relieved welded specimens are about 5 per cent lower in tensile strength, 10 to 20 per cent higher in elongation than those of non-stress-relieved specimens. Stress-relieving shall be within the range of 1,150±25 F for 1 hr per inch of thickness. Specimens shall be heated in a suitable furnace at the rate of 300 to 350 F per hour until a temperature of 1,150±25 F has been attained. After this temperature has been reached, it shall be maintained for 1 hr for each inch or fraction thereof of the maximum thickness of the section. The specimens shall be cooled at the same rate specified for heating and may be removed from the furnace when the temperature of the plates has reached 300 F.

[b]This value shall be obtained with the full-section tension test specimen. All other values in this column shall be obtained with the all-weld-metal tension test specimen.

These rods may be made by any method which will yield a product conforming to the requirements of the specification. Standard lengths are 36 in.; standard diameters, 1/16, 3/32, ⅛, 5/32, 3/16, ¼, 5/16 and ⅜ in.

The only limitation placed on the chemical composition of the rods is that the sulphur content cannot exceed a maximum of 0.045%.

Table II is a comparison chart for identifying the specific trade names of leading manufacturers with the various welding rod classification numbers.

Table II. Comparative Welding Rods Meeting AWS-ASTM A251-42T Specifications

Type / Mfgr.	GA50	GA60	GA65	GB45	GB60	GB65
Airco	7	1 4 11 C-Mo				2 Va 5 Ni Simplex
General		50		10		
Linde		1 H. T.		7 Drawn Iron	1 H. T.	32 C.M.S.
National	6	6		5	1	6
Page		Hi-Tensile M		C Armco	Hi-Tensile M	
Reid-Avery				Copper Coated Red Label		
Ryerson				Copper Coated 206		
Standard	A Copper Coated		Ni Steel High Test	B Copper Coated		
Universal	RGS 11	RGS 13	RGS 15	RGS 10	RGS 13	RGS 15

Make Good Piping Better

with

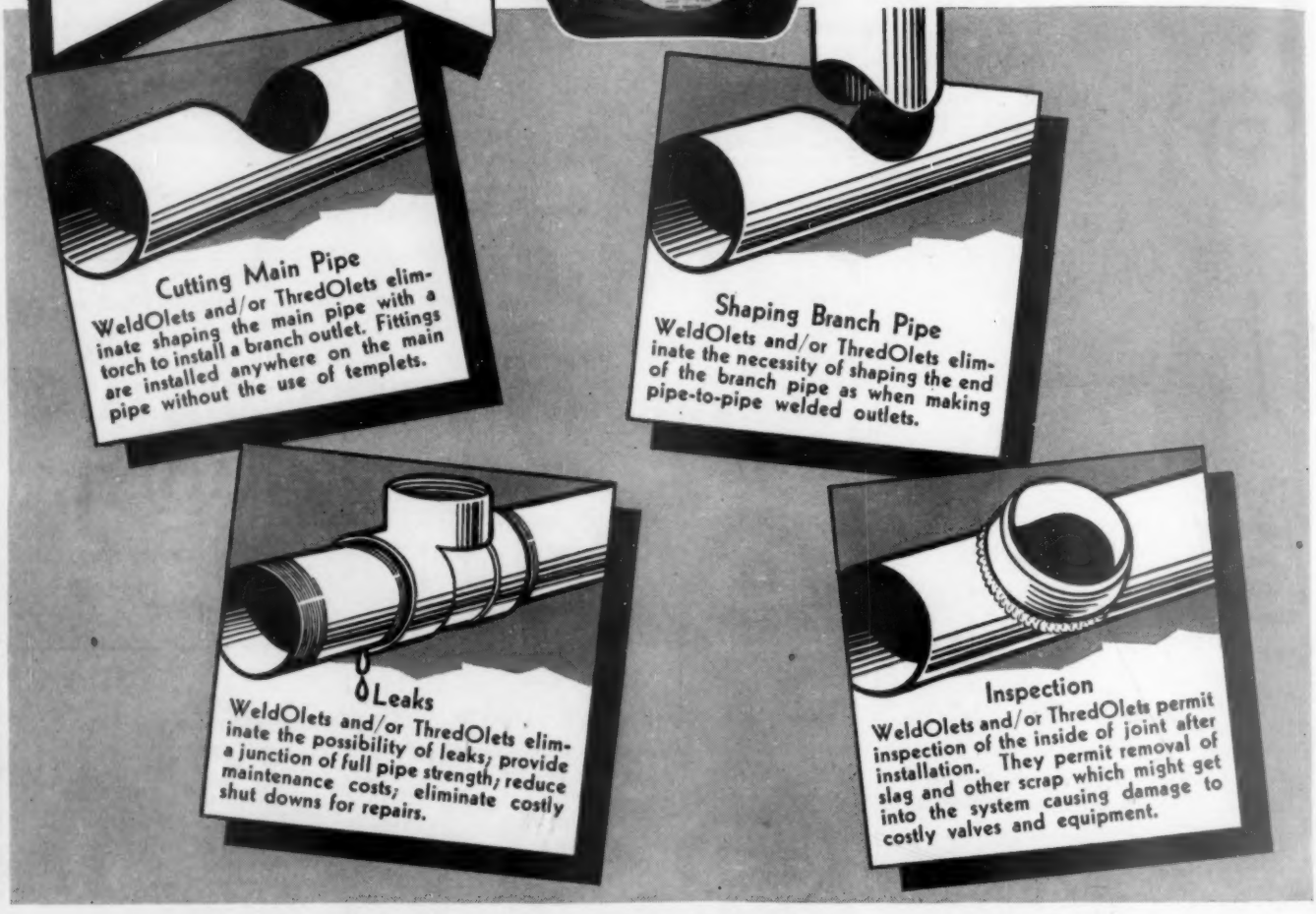
WELDOLETS · THREDOLETS

3 Types Meet Every Need

WeldOlets for butt welded branch connections.

ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type welded branch connections.



Cutting Main Pipe

WeldOlets and/or ThredOlets eliminate shaping the main pipe with a torch to install a branch outlet. Fittings are installed anywhere on the main pipe without the use of templets.

Shaping Branch Pipe

WeldOlets and/or ThredOlets eliminate the necessity of shaping the end of the branch pipe as when making pipe-to-pipe welded outlets.

Leaks

WeldOlets and/or ThredOlets eliminate the possibility of leaks; provide a junction of full pipe strength; reduce maintenance costs; eliminate costly shut downs for repairs.

Inspection

WeldOlets and/or ThredOlets permit inspection of the inside of joint after installation. They permit removal of slag and other scrap which might get into the system causing damage to costly valves and equipment.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line—and always with ease and economy. They are equally well adapted to prefabricated or "on-the-job" assemblies. Because of their patented, funnel-shaped intake aperture they improve flow conditions. Carried in stock for all standard pipe sizes up to 12" in size-to-size or reducing sizes—and can be furnished on special order in sizes up to 24". Stock fittings are drop forged steel, but to meet special conditions will be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for a copy today.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

ARMY NAVY Star Awarded July 10, 1943

WELDOLETS · THREDOLETS

TRADE MARKS · REG. U.S. PAT. OFF.

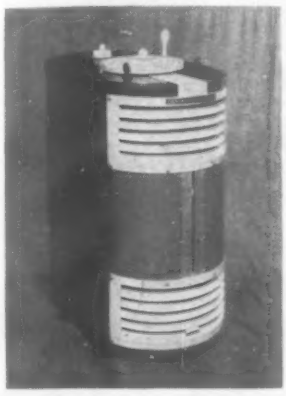
Welded Outlets for Every Piping System

New Products to Use

(Continued from page 66)

Outdoor A-C Welder

★ **General Electric Co.**, Schenectady, announces a new 500 amp A-C welder especially designed for use in shipyards and other outdoor locations where ex-



G-E transformer-type arc welder, Model 6WK2C5, rated 60 cycles, 500 amp, 220/440 volts. It is especially designed for outdoors.

posure to the weather must be encountered. It has a welding current range of from 100 to 625 amp at 40 volts. An "idlematic" control automatically reduces the output voltage to less than 35 volts whenever the arc is not in operation, providing full power for welding the instant the arc is struck. The control also includes a switch (operated by a handle extending through the top of the case) for starting or stopping the welder manually.

This welder is protected against the entrance of rain or snow by dripproof top openings and by a sealed window over the current indicator. Wide louvers serve both to shed water and to keep the air velocity low. The welder is provided with the standard features of G-E indoor A-C welders, including built-in power factor improvement, fingertip adjustment, stepless current control and fan-forced ventilation.

» «

Heat-Treating Furnace

★ The Holden **Type 230** salt bath heat-treating furnace is a versatile unit comprising three pots, which are used as follows:

Pot No. 1 (1,400 to 1,800 F): preheating high speed tools; heating water- and oil-hardening steels or alloy steels such as high-carbon-high-chrome or stainless types; carburizing; silver soldering.

Pot No. 2 (1,900 to 2,350 F): hardening all types of high speed steels; copper brazing; heating forgings.

Pot No. 3 (1,000 to 1,400 F): quenching high speed tools from their hardening temperatures; tempering; nitriding; blueing; descaling forgings and similar parts.

Pots Nos. 1 and 3 are removable and interchangeable, permitting several different baths to be use in the same fur-

Amsco Hard-Surfacing Rod
Gives New Life to Concrete Tampers

The activity in the manufacture of concrete products and the difficulty in obtaining replacement parts for equipment have resulted in the greater use of Amsco No. 459 Hard-Surfacing welding rod by the industry.

Tamping bars, such as those shown (A-178), are used in compacting the cement-gravel or cement-slag mixture from which concrete blocks for foundations and building walls are made. The bottoms of the tampers are subjected to drastic wearing action, because the material with which they come in contact is highly abrasive. Impact is also a destructive factor, because the tampers move up and down, striking the mixture frequently and with much force.

The tamping bars shown on the right in the picture have worn down in service and are due for an application of Amsco No. 459 Hard-Surfacing welding rod. Without it, they would wear down much faster than they do. By applying a protective coating of this tough, wear-resistant rod when it is needed, as shown on the left in the picture, the tampers largely retain their original dimensions and contour.

Several other brands of hard-surfacing rod were tried on the application illustrated, but the customer has standardized on Amsco No. 459, because this rod, with its high chromium, molybdenum and carbon contents, gave 20% more service than any other at the lowest cost per pound of rod.

Amsco Hard-Surfacing welding rods include No. 459 for severe abrasion and moderate impact; No. 217 for abrasion at temperatures up to 1000° F.; and Economy Hardface for both impact and abrasion. They have often proved the means of eliminating frequent shutdowns and high replacement costs.

Write for Bulletin 941-W on Amsco Welding Products.

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
AMERICAN Brake Shoe COMPANY
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

NATIONAL METAL CONGRESS *and* WAR CONFERENCE DISPLAY

"BASE OF OPERATIONS" for the Metal Industry

Chicago PALMER HOUSE **October 18 thru 22**

America's metal industry will move its "base of operations" to Chicago's Palmer House the week of October 18 to take full advantage of the 25th annual National Metal Congress and War Conference Display.

Devoted to increased production of war products, to conservation of materials, and to postwar planning, this year's Congress and Conference Display will bring vital new developments and ideas to the attention of thousands of war production executives and engineers in the metal industry.

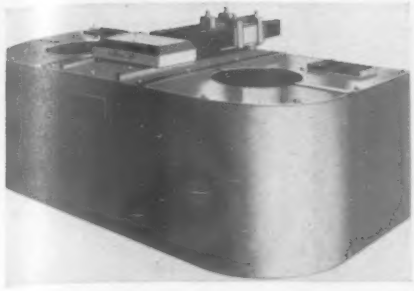
More than a hundred technical lectures will be presented by the four cooperating societies. Leaders in the metal industry and government will participate in the Special War Production and Conservation Sessions held each day by the American Society for Metals, sponsor of the event.

Hundreds of manufacturers will participate in the War Conference Display to be held in the Palmer House itself. These companies will have their engineers, their literature, light equipment and parts at these Conference Display rooms to help metal men solve their problems and increase production.

For complete information on these War Conference Displays — write or wire the American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio. Phone Endicott 1910.

NATIONAL METAL CONGRESS AND WAR CONFERENCE DISPLAY

Under the direction of the American Society for Metals, in cooperation with the American Welding Society, the Wire Association, and the Institute of Metals and Iron and Steel divisions of the American Institute of Mining and Metallurgical Engineers.



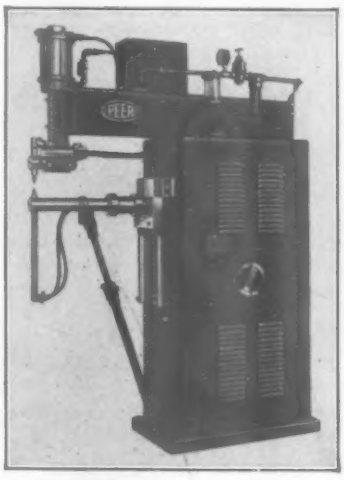
Type 230 furnace for heat treating by the salt bath process. Its three pots provide different temperature ranges.

nace. The **A. F. Holden Co.**, New Haven, Conn.

» «

Press Welders

★ The new **P-20** line of press-type spot welders is announced to meet high-speed production requirements; a speed of up to 110 strokes per minute may be attained. Pressure, weld time, hold time and off time are automatically controlled; the cycle may be varied to suit different welding jobs.



Peer P-20 automatic press-type welder. It is offered in both 20 and 30 kva capacities.

The upper electrode is actuated by a double-acting air cylinder, and the electrode pressure can be adjusted by an air-pressure regulating valve. Current may be adjusted from 50% to 100% of maximum capacity by an eight-point selector switch. This welder is furnished in two capacities—20 and 30 kva—each of which is available with throat depths of either 12 or 24 in. **Pier Equipment Mfg. Co.**, Milton and Cross Streets, Benton Harbor, Mich.

» «

Elastic Headband

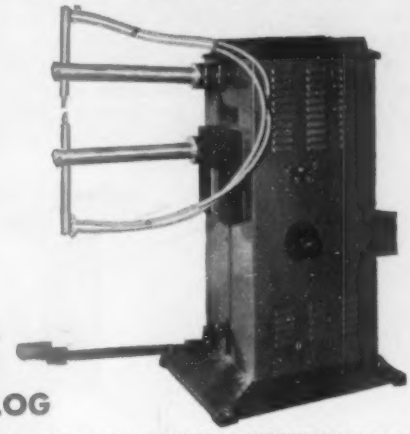
★ An elastic-action headband that contains no rubber is being offered for goggles or respirators; in fact, wherever rubber-elastic headbands have been in use. The **"Holdtite,"** as this product is known, is said to be easy to adjust and to hold without loosening. **Carter-Lockard Co.**, 225 West 11th St., Los Angeles.

NOW... Speed Up Your PRODUCTION WELDING

with this Improved, Low Cost

UNIVERSAL SPOT WELDER

Faster output and lower welding costs are yours with this improved Model J Universal Spot Welder. Designed for general work, it contains several new features not found in resistance welders selling for many times the price. You get more uniform welds as a result. It is rugged, efficient, yet is constructed so simply that there is practically nothing to get out of order. Very economical in its use of current.



Check These Important Features!

Variable switch permits different heat intensities for welding different metals. Swivel foot pedal permits adjustment for right or left operation. "Green" help can produce excellent welds with this easy-to-operate, low-cost equipment.

SEND FOR CATALOG

UNIVERSAL POWER CORP.

Universal Power Corp.—4899 Euclid Ave. Cleveland, Ohio.
Gentlemen:
Please send your new catalog, giving full details and prices on the Model J Spot Welder and your full line of low-cost welding equipment and accessories.
NAME.....
ADDRESS.....
CITY.....STATE.....

Saved...

up to 160 MAN-HOURS per Welder Unit*...

... with BADGER D-C Generator Welder FILTER

IN ONE LARGE WAR PLANT (name on request) process and atmospheric dusts drawn into Generator Welders caused an average of FOUR "down-times"* per year for repair and overhauling—lost up to 160 MAN-HOURS per unit!

BADGER D-C Generator Welder PERMANENT FILTERS were installed. Since then, over four years ago, not ONE Welding Unit has been out of operation for repair caused by process and atmospheric dusts. Savings in Man-Hours, Money and Lost Production time more than paid the cost of each BADGER PERMANENT FILTER during the first year.

You, too, may enjoy similar benefits on YOUR Generator Welding Units! The BADGER Permanent-type Filter is easy to install—and inexpensive. Write for information TODAY! Send us the complete information to identify the make, style and model of Welder used.

* "Frozen" or clogged rotors—Excessive wearing of generator and Exciter Brushes, based on an average of 7488 machine hours per year.

Badger MANUFACTURING & SALES COMPANY
335 EAST BROWN STREET
MILWAUKEE 12, WISCONSIN

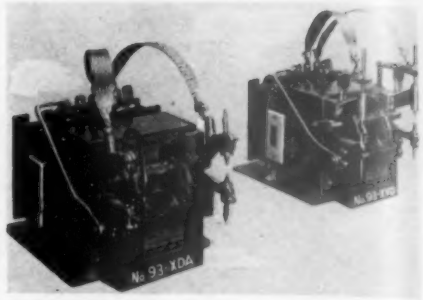
Manufacturers of PERMANENT Filters for Heating, Ventilating, Air Conditioning Aircraft and Industrial use

Welding Shields

★ New models of **Huntsman** acetylene and arc welding shields embody a patented locking device which holds the shield in the correct position before the face. This assures that the line of vision will pass through the lens at right angles to the surface of the glass. It also holds the shield firmly above the head while the weldor is preparing, chipping or inspecting his work. When welding is resumed, a slight nod of the head will lower the shield into working position.

Hunstman shields are available in six models, ranging in weight from 1 to 1½ lb. **Davis Emergency Equipment Corp.**, 55 Halleck St., Newark, N. J.

Huntsman welding shield. It has a patented locking device and a comfortable, easily adjusted headgear.



Small spot welders. The one on the left is equipped with rocker arm and that on the right with a vertical press. Both are designed for bench welding of light gauge sheet or wire.

Bench Spot Welders

★ **Eisler Engineering Co.**, 740 South 13th St., Newark 3, N. J., announces two types of a new duplex bench spot welder for light gauge sheet and wire. These are production machines, especially suited to such work as the welding of radio tubes, incandescent lamps, optical and jewelry parts, metal novelties, etc. One model is equipped with rocker arm (left in picture) and the other supplied with a vertical press arrangement.

Each unit consists of two independent small welding machines built together with one transformer and a rheostat for finer heat adjustment. Welders are foot-operated by means of two treadles and chains. The first step on the treadle brings the operating jaws together, squeezing the work by means of a lever system. Further pressure on the treadle effects contact, causing a high welding current to flow through the work until the circuit is automatically broken. A skillful operator, claims manufacturer, can weld from 120 to 175 spots per minute with either type of these machines.

» «

Fingerless Glove

★ An unusual glove is the new "fingerless" type, **No. 14962**, developed by the **Industrial Gloves Co.**, Danville, Ill. It is made of chrome-tanned cowhide, reinforced vertically with steel ribbons and stitched with steel wire.

Steel-reinforced glove without fingertips. It is used where finger touch is necessary but protection of the rest of the hand must be maintained.

TIME OUT

Failure of vital production equipment today, means plenty of trouble . . . because war production makes no allowance for "time out". Production schedules immediately start to suffer.

But you can rely on MARQUETTE Welders to keep your production line clicking. Backed by many years of leadership in the A.C. field, these stalwart machines are built to stand the "gaff". Extra sturdy construction—no moving parts to wear out—no dials or nuisance gadgets to get out of order—all asbestos insulation, providing more than ample heat resistance, assure dependable, top-flight welding performance on a 24 hour daily basis.

THESE OUTSTANDING MARQUETTE FEATURES SPEED WAR PRODUCTION

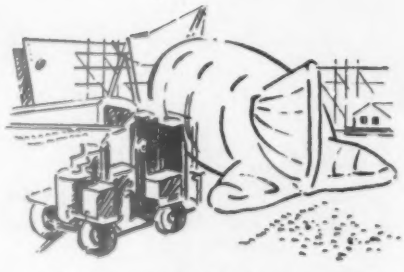
- ★ LOW INITIAL COST
- ★ NEGLIGIBLE UPKEEP
- ★ LOW COST OPERATION
- ★ FAST, SIMPLE OPERATION
- ★ SUPERB ARC PERFORMANCE
- ★ FAST, FLAWLESS WELDS
- ★ 10 MODELS, 125 to 400 amps.
- ★ 10 DAY DELIVERY

Send for free, 24 page, illustrated booklet.
MARQUETTE MFG. CO., INC. Minneapolis, Minn.

MARQUETTE
REG U.S PAT OFF
A.C. ARC WELDERS

Another *Pioneering "First" for Independent—Independent* Mobile High-Pressure Hydrogen Producing Plants for Uncle Sam and his allies *exclusively*. Many of these Martian-appearing units have already been located at points of vantage—ready to go into action in defense of the nation . . . solving a difficult storage and transportation problem.

Foresight—exhaustive research, here and abroad by *Independent* Engineers—gives *you*—along with the millions of other Americans the advantages and extra security that mobile High-Pressure Hydrogen producing plants and *mobile Oxygen Generators* (another *Independent* "First") are providing.



Hydrogen—Inflated barrage balloons are an important defense factor against enemy air-craft. Independent Mobile Hydrogen Generators provide an immediate source of hydrogen supply at the scene of action where it is needed most.

Uncle Sam NEEDS Experienced Men to Operate These Machines

If you know of anyone now in the service, or scheduled to be, who has had oxygen or hydrogen producing plant experience, suggest that they investigate the opportunities in serving their country in this field. Those in service consult with their superiors—those entering service should consult with their local recruiting office.

If further details are wanted, we will be glad to supply them—address

Independent Engineering Co.

101 West Second Street, O'Fallon, Illinois

News of the Industry

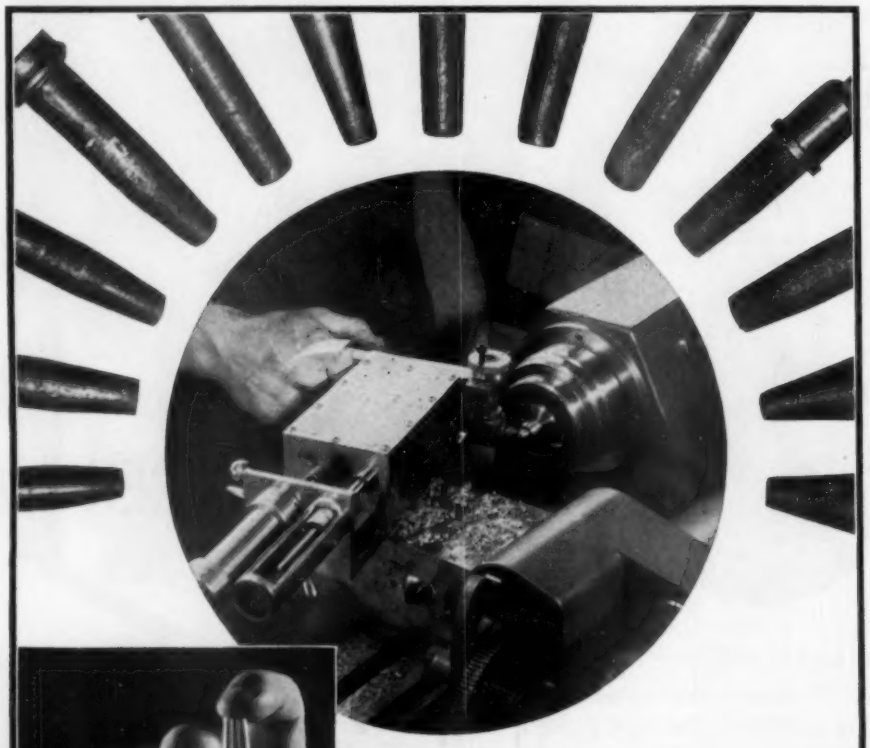
Repair Shops Given AA-2 Rating for Welding Rod

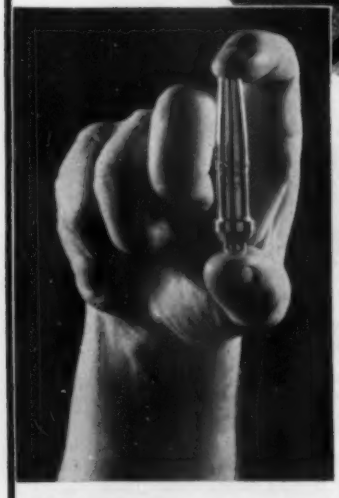
A preference rating of AA-2 has been assigned to repair shops for the acquisition of welding rod, according to Direction 10 of CMP Regulation No. 5, issued on July 28 by the War Production Board. A shop may use this rating to buy as much rod in any month as it used during the previous month, up to a limit of $100 for any one month. Any repair shop may purchase up to $15 worth of welding rod in a month regardless of what amount it used in the previous month.

A repair shop which requires more welding rod than it can get by its AA-2 rating may secure additional rod by: (1) using a customer's rating for a specific job—but only for a specific job and not to build up or replace inventory; (2) applying on Form PD-1A for a rating for a specified amount of rod; (3) applying on Form CMP-4B for an allotment and rating covering a quarter's needs.

Both customers' ratings and PD-1A rating may be used to supplement the rod obtainable with the AA-2 rating, but if the shop uses the controlled materials application, CMP-4B, it cannot use the AA-2 rating, customers' ratings, or PD-1A during the same quarter.

» «





Send US YOUR OLD WELDING and CUTTING TIPS for Reconditioning

Don't throw away your old worn out welding and cutting tips—send them to us and we will recondition them. We can salvage up to 70% of all tips sent to us. Here is a chance for you to help conserve on critical material by re-using the tips you thought were beyond repair. Send your order in today, it will receive prompt attention.

DOCKSON CORPORATION

DOCKSON 383 WABASH AVENUE DETROIT, MICH.

Welded Ship Proves Her Metal

The S.S. *William Moultrie*, a Liberty ship launched a year ago May, has distinguished herself in a transAtlantic convoy, according to a production communique from the United States Maritime Commission to the workers of the North Carolina Shipbuilding Co.

In a running fight that lasted a week, the crew of this vessel downed eight Nazi planes, damaged twelve, chased off a submarine and exploded a torpedo with a direct hit as the "tin fish" swum toward them. The *Moultrie* reached her destination unharmed.

Evidence of the ability of this welded ship to take it and come back for more is provided in a recent statement made by Frank Maslany, one of the *Moultrie's* crew. Said Seaman Maslany:

"On the way to Russia, we were bombed on ten different occasions. A ship carrying explosives was blown up right in our face. The concussion was so great it knocked everybody flat on their backs. The *Moultrie* was literally blown clear out of the water. It hit so hard coming down that it bounced back up again. After the second bounce, the bow took a deep dive, leaving the stern high in the air, but she settled and righted herself. Later investigation proved that not a quart of water had leaked through her seams during this severe strain. No direct hits were made on the *Moultrie*, but near misses sprayed her with shrapnel."

» «

National Safety Congress Scheduled for Oct. 5, 6, 7

Being held in Chicago on October 5 to 7, the 1943 National Safety Congress will be devoted exclusively to accident problems which have a direct bearing on the prosecution of the war. There will be more than 500 program participants in the 200 sessions which are to be held at the Sherman, LaSalle and Morrison hotels.

One of the outstanding features planned for industrial leaders is a Labor and Safety session on October 7. Daniel S. Ring, director of the Division of Shipyard Labor Relations, U. S. Maritime Commission, will serve as chairman.

HEAVIER SHIELDING MEANS LONGER LIFE

The qualities to look for in tubes for resistance welding are: adequate and sustained thermal radiation, plus *long life* in service.

UNITED Tubes are engineered for maximum electronic efficiency and mechanical "toughness". The protruded filament surface is mounted on a vertical plane, and affords an increased emitting area. At the same time, the filament is given an unusual degree of *rigidity*.

Another factor which adds to the extra mechanical ruggedness of UNITED Tubes is their filament *shielding*—which embodies a larger area than is found in ordinary types of tubes.

PREFERRED FOR HEAVY DUTY

These combined qualities, in addition to other engineering advancements, higher grade component parts and workmanship, make UNITED Tubes an outstanding favorite where engineers insist on "heavy duty" tubes that function perfectly over longer periods of use.

Why guess or gamble? PROVE the merit of UNITED Tubes on your toughest welding jobs. Try UNITED for your next replacement needs.

UNITED

ELECTRONICS COMPANY

NEWARK NEW JERSEY

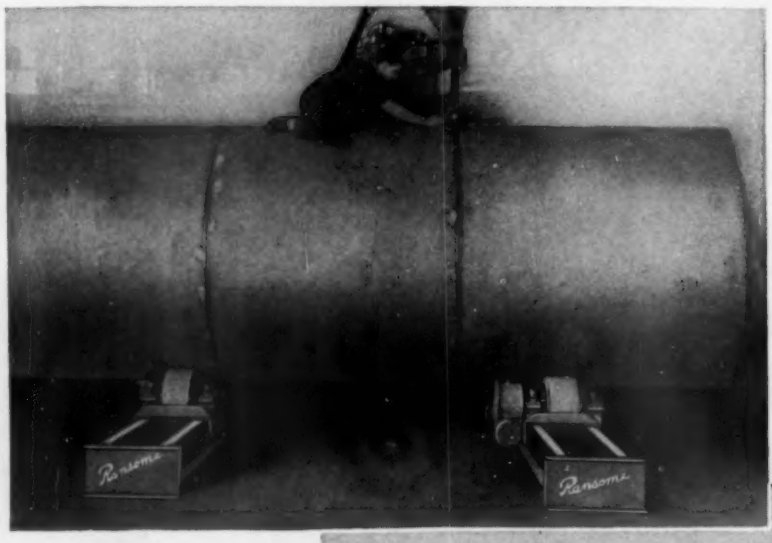
Our local jobber in your city can obtain UNITED 972-A for you on properly rated orders placed reasonably in advance of actual needs. Order from him, or direct from us.

Women Weldors Trained at Hobart Trade School

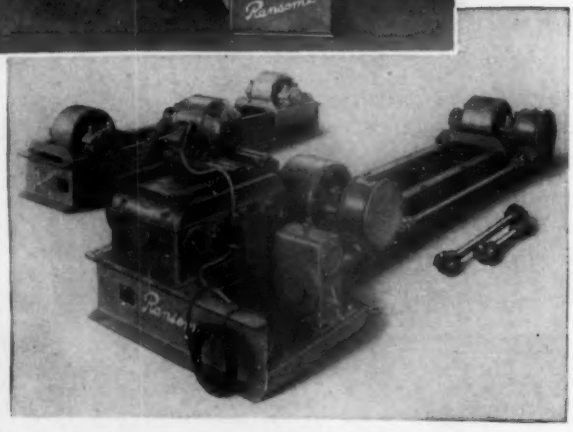
Normally a husky, hairy-chested, he-man sort of place, the Hobart Trade School at Troy, O., is succumbing to the feminine influence. This welding school is now specializing on women trainees to work with and in place of male weldors in war industries.

Originally opened in 1941, the Hobart school has graduated more than 4,500 students in its 160-hr course in arc and oxy-acetylene welding. It is a non-profit organization established for the betterment of the welding profession. Robert Bercaw, expert weldor with 23 years of experience in the field, is chief instructor.

Recent women graduates of Hobart Trade School who are now working on the production line.



This equipment was developed by Ransome to meet the particular requirements of cylinder welding. If your welding presents special problems, call on our engineers for assistance.



» TURNING ROLLS CAN STEP UP YOUR CYLINDER WELDING...

For manual or automatic welding . . . here's the equipment that will enable your welders to produce at their top capacity. Smooth rotation at any desired speed . . . forward or reverse . . . is provided by a variable-speed drive with push-button control.

Work ranging from 2 to 14 feet diameter can be accommodated by shifting the position of the rollers.

Other Ransome Positioners include types and capacities for handling weldments of any size.

POSITIONING PAYS...WRITE FOR LITERATURE

Ransome WELDING POSITIONERS

INDUSTRIAL DIVISION • RANSOME MACHINERY COMPANY • DUNELLEN, NEW JERSEY

New Utah Steel Works to Supply Pacific Coast

Substantial completion of the new Government-owned steel mill at Geneva, Utah, is scheduled for the end of this year. Under the terms of an agreement with Defense Plant Corp., the new Geneva Works will be operated for the RFC subsidiary by Geneva Steel Co., a newly organized U. S. Steel subsidiary.

These Utah facilities, costing approximately $180,000,000, were ordered by the Government primarily to provide steel for the war shipbuilding needs of the Pacific Coast. The main plant embraces a site of more than 1,600 acres and was created from scratch in the midst of what was an agricultural district less than two years ago. When completed, Geneva Works will have an annual capacity of approximately 1,200,000 tons of ingots, 700,000 tons of plates and 250,000 tons of structural steel.

» «

"Torch Talk" Is New Victor House Organ

Volume 1, Number 1 of a new company house organ in the welding field made its appearance last month. This is *Victor Torch Talk*, a well-edited, snappy-looking magazine of 32 pages, which is published by the Victor Equipment Co., San Francisco.

"Our objectives are broad," explained E. L. Mathy, vice-president of Victor, who is editing the company's new publication. "We want to stimulate maximum coöperation among a great number of new employees. We want to tell our coworkers how the products they manufacture help in our War Effort. We want to let them know something about their industry and about their company. We want to acquaint them with such Government orders as will affect their lives. And we want to try to do all of these things without preaching."

» «

Baldwin Subcontracts $65,000,000 War Orders

A total of 1,035 subcontractors scattered throughout 28 states and the District of Columbia are sharing in the Baldwin Locomotive Works' program of "spreading the work." This concern and its wholly owned subsidiaries awarded subcontracts totaling approximately $65,000,000 on war orders during the first six months of 1943.

I'll Guard the home front

—against the forces of GENERAL WEAR

"HARCOTE" is ready! Ready to protect softer steels against the ravages of wear — to help you keep machinery on the job — now — when replacement parts are so difficult to obtain.

P&H "Harcote" is a hard surfacing electrode — both *hard* and *tough!* It's ideal for refacing parts subject to severe wear and abrasion, such as shovel teeth, scraper blades, farm implements, sand and rock handling equipment, and many other applications on carbon steel, low alloy and high manganese surfaces. "Harcote" is just one of the family of P&H Alloy Electrodes which answer every welding need. P&H representatives will gladly assist you. Or write us for literature and procedures.

Ask also for information about P&H Arc Welding Machines.

P&H Alloy ELECTRODES

ARMY E NAVY

A new star has been added to P&H's award for excellence in war production.

General Offices: 4513 W. National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER CORPORATION

WELDING ELECTRODES · MOTORS · HOISTS · ELECTRIC CRANES · ARC WELDERS · EXCAVATORS

Air Reduction Co. Wins Maritime "M"

In recognition of "conspicuous and outstanding production achievement," Admiral Emory S. Land, chairman of the U. S. Maritime Commission, recently presented the Award of the Maritime "M" and Victory Flag to the Air Reduction Co., Inc. In a colorful ceremony at the corporation's Bethlehem, Pa., oxygen plant, Chairman Land paid high tribute to the importance of oxy-acetylene flame-cutting and arc welding in furthering America's giant shipbuilding program.

"New methods of welding and cutting, of making shapes and forming steel, which the workers of this company have developed, have greatly accelerated our ship production program," he said. "The building of a Liberty ship requires the cutting of approximately 3,500 tons of steel plates. Without the cutting tools and gases such as this company furnishes, this process would indeed be a slow one. Instead of building Liberty ships with an average of approximately 600,000 man-hours, we might have to double that figure. It would mean we would build only half the ships we are building today."

Twenty-two employees, chosen to represent the 8,016 men and women working in 159 Airco plants throughout the country, were present to receive the Maritime Commission Labor Merit Badge. W. J. Strawn, oxygen plant worker, upon receiving his badge from Admiral Land, pledged continued all-out support from every employee in every plant.

Acceptance of the "M" award on behalf of the company was made by C. E. Adams, chairman of Air Reduction Co., Inc., and former chief of the Iron and Steel Branch of WPB.

» «

Saves Molybdenum, Wins Army-Navy "E"

United Electronics Co., Newark, N. J., was last month awarded the coveted Army-Navy "E" flag for excellence of production. "The company has made a vital contribution to the war effort in the saving of tons of critical materials," asserted the principal speaker, Colonel C. O. Bickelhaupt, Commanding Officer, Eastern Signal Corps Replacement Training Center, Fort Monmouth.

An example of how critical metals were saved is provided by one particular type of electronic tube made for the Signal Corps. It had been common practice to make the anode plate of pure molybdenum sheet. The United Electronics Co. succeeded in developing a zirconium-treated graphite anode which will save over one ton of pure molybdenum rolled sheet on this one contract alone.

» «

U. S. Metallurgists to Lecture in Brazil

Advanced U. S. practices in the application of the science of metallurgy will be communicated during the coming year to scientists and industrialists of our ally Brazil through a technical educational project established at the Escola Politecnica of the University of São Paulo. Four outstanding authorities of the United States have been appointed to give a year's course in fundamental metallurgy, on a graduate level. Each instructor will remain in residence in Brazil for three months during the extent of his lecture series.

The lecturers are: Dr. A. Allan Bates, manager of the chemical and metallurgical dept., Westinghouse Electric and Mfg. Co. research laboratories; Dr. Robert F. Mehl, head of the department of metallurgical engineering and director of the metals research laboratory of Carnegie Institute of Technology; Professor Arthur Phillips of the Hammond Metallurgical Laboratory, Yale University; Professor Gregory Jamieson Comstock, director of the powder metallurgy laboratory at Stevens Institute of Technology.

» «

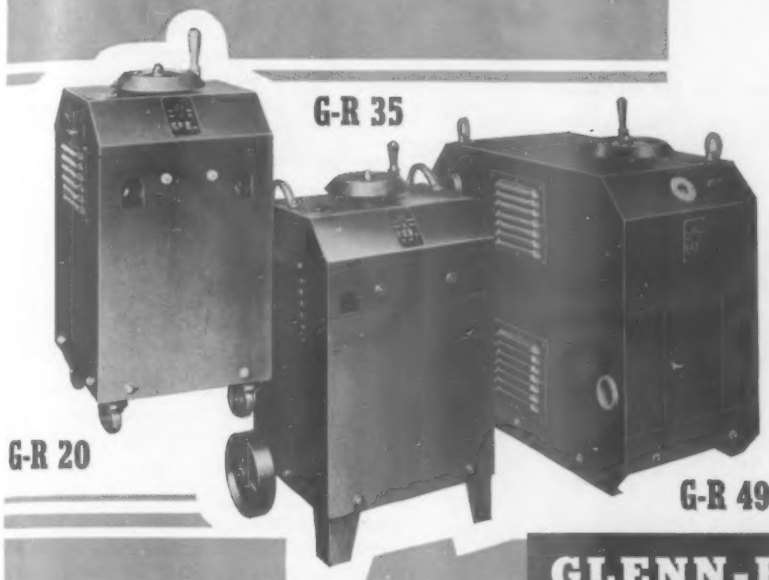
Louisville Organizes a Local AWS Section

Theodore Lewis, superintendent of the oxygen-acetylene operations and equipment of the Jeffersonville Boat & Machine Co., has been selected to act as temporary chairman-treasurer of an organization committee for a new Louisville section of the American Welding Society. Memberships are being secured at a good rate, and it is the hope of the organization committee that a charter meeting may be called very shortly.

On any surface... on any job
SKILSAW
SANDER-GRINDER
gives you
FINER FINISHING FASTER!
SKILSAW Model "SL" SANDER-GRINDER. Speeds metal cleaning with a wire brush, quickly removes rust and scale—prepares for finishes.
SKILSAW DISC SANDER. Smooths down welding beads with sanding disc. Flexible pad conforms to concave or convex surfaces... speeds up all work.
Whatever your surfacing jobs may be, it's a safe bet that SKILSAW Model "SL" SANDER-GRINDER will do them easier, better, faster! It quickly prepares surfaces for welding, grinds welds down swiftly . . . cleans rust, scale and grit from metals and castings... files, sands, buffs and polishes with a wide variety of accessories. And everywhere Model "SL" greatly increases output per man per minute because it's lighter, easier to handle—more powerful, faster-working!
Model "SL" is typical of all the SKILSAW PORTABLE GRINDERS, BELT SANDERS, DISC SANDERS that you'll find on the job in America's busiest war plants. Your distributor will gladly demonstrate them on your own work.
SKILSAW, INC., 4763 Winnemac Ave., Chicago
New York • Boston • Buffalo • Philadelphia • Cleveland • Detroit
Indianapolis • St. Louis • Kansas City • Atlanta • New Orleans
Dallas • Los Angeles • Oakland • Portland • Seattle • Toronto, Can.
SKILSAW PORTABLE ELECTRIC TOOLS
★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

G-R WELDERS

THERE'S A G-R FOR EVERY WELDING JOB...



G-R BUILDS manual welders, power supply welders for automatic operation and combination machines for hand or automatic welding, in sizes from 125 to 2500 amperes. All incorporate G-R stepless heat control, high efficiency and operator safety. Industrial models are *power factor corrected.*

SEE YOUR G-R DISTRIBUTOR

GLENN-ROBERTS COMPANY

1009 FRUITVALE AVENUE
OAKLAND, CALIFORNIA

2107 ADAMS STREET
INDIANAPOLIS, INDIANA

P. O. Box 1814, Washington, D. C.

ANNOUNCING

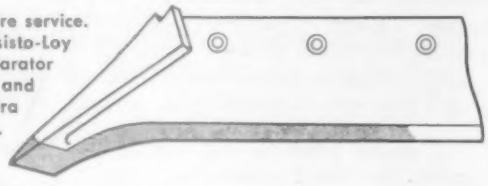
RESISTO-LOY "AG"

("AG" meaning Agricultural)

A Specially Designed Hard Facing Metal For All Agricultural Purposes

Approved By War Production Board and Conforms to W.P.B. Limitation Order L-223. Available on Priority of AA4 or Better. Apply to your local WPB office for forms.

Hard enough to resist the most severe service. Tough too—will not chip. Apply Resisto-Loy "AG" to plow points and shares, separator cylinder teeth, disc plows and harrows, and feed mill hammers. See how much extra service a good hard facing will give you. Available in both oxy-acetylene and electric arc types for AC or DC machines.



Write the following distributors:

CALIFORNIA—Yonkers & Johnson, SO. DOS PALOS
FLORIDA—Welding Engineering Co., MIAMI
INDIANA—Purity Cylinder Gases, Inc., WARSAW
KANSAS—R. T. Brown Co., Ltd., SALINA
KANSAS—J. A. Richardson Mfg. Co., CAWTER CITY
LOUISIANA—Woodward, Wight & Co., NEW ORLEANS
MAINE—Brown-Wales Co., LEWISTON
MARYLAND—Southern Oxygen Co., HYATTSVILLE and BALTIMORE
MASSACHUSETTS—Brown-Wales Co., BOSTON
MICHIGAN—Welding Metals & Mfg. Co., DETROIT
MICHIGAN—Purity Cylinder Gases, Inc., GRAND RAPIDS, KALAMAZOO and LANSING
MISSISSIPPI—J. E. Dilworth Co., VICKSBURG
MISSOURI—Puritan Compressed Gas Corp., KANSAS CITY
MISSOURI—Ross-Frazer Iron Co., ST. JOSEPH
OHIO—Universal Power Co., CLEVELAND
OKLAHOMA—Big Three Welding Equipment Co., TULSA and OKLAHOMA CITY
OREGON—Industrial Air Products Corp., PORTLAND
PENNSYLVANIA—Arcway Equipment Co., PHILADELPHIA and PITTSBURGH
PENNSYLVANIA—Shop Supply Co., PITTSBURGH
TENNESSEE—J. E. Dilworth Co., MEMPHIS
TENNESSEE—Southern Oxygen Co., KINGSPORT
TEXAS—Big Three Welding Equipment Co., FORT WORTH, HOUSTON, EL PASO, SAN ANTONIO and AMARILLO
TEXAS—Corpus Christi Oxygen Co., CORPUS CHRISTI and McALLEN
VIRGINIA—Southern Oxygen Co., RICHMOND
WASHINGTON, D. C.—Southern Oxygen Co.

Resisto-Loy **COMPANY**
GRAND RAPIDS, MICHIGAN

Lincoln Electric to Train Weldors in U. S. Shipyards

The United States Maritime Commission announced recently that it had accepted the offer of the Lincoln Electric Co., Cleveland, to train and instruct weldors in shipyards engaged in Maritime Commission work. The company will furnish training facilities in Cleveland, including the necessary equipment and staff, for training supervisors and teachers who will operate the various welding schools in Maritime Commission yards. Lincoln Electric will also provide the Commission with welding engineers to assist the yards in raising their welding standards.

Importance of the application of welding to shipbuilding is evidenced by a letter from President Roosevelt to Prime Minister Churchill that was recently made public. Said President Roosevelt: "There has been developed a welding technique which enables us to construct standard merchant ships with a speed unequaled in the history of merchant shipping."

» «

Six Points to Remember When Using New Solders

Prewar solders were composed of tin and lead in about 50-50 ratio, but the solders being used today contain not more than 20% tin, with perhaps small amounts of silver, bismuth or antimony. A hotter soldering iron and different technique is called for.

How to make better soldered joints with tin-shy solders is explained in a communication recently issued by the metallurgy committee of the General Electric Co. The following six points are cited:

"1. Keep your work clean. Varnish, grease, oil, dirt, rust or corrosion products prevent the flux from acting and the solder from alloying with the parent metal.

"2. Keep in mind that the purpose of the soldering iron or torch is not to melt the solder but to heat the work until the solder will flow when applied to it.

"3. Keep the soldering iron clean. To have the quickest possible heat transfer from the iron to the work, the tip should be designed to fit closely against the work.

"4. Investigate different methods. A hotter electric iron, high frequency or carbon resistance soldering tools may do the job better.

"5. Design your joints to have 0.003 to 0.005 in. solder thickness and so that the two parts overlap. Lap or seam-type solder joints are better than butt-type joints. (Have the solder fill the seam completely.) Heavy fillets add little strength to the joint and waste solder.

"6. Don't give up a new solder after one unsuccessful trial—the chances are your technique is not what it should be for that particular solder."

Photograph courtesy of Air Reduction Sales Co. and Combustion Engineering Co.

CONTROL of OXY-ACETYLENE PROCESSES

MOTO METER Pressure Gauges are designed to permit most effective and economical use of oxy-acetylene flame processes. Their sensitive pointers and clearly legible dials provide pressure facts that help to insure proper welds and clean cuts.

. . . make possible correct pressures for each operation.

. . . aid in conserving vital oxygen and acetylene gases.

Exclusive construction incorporates grid-plate safety feature shown at right. MOTO METER Pressure Gauges are listed as approved by Underwriters Laboratories.

EXTRA PROTECTION

for operator and plant equipment is obtained through grid retainer plate, exclusive with MOTO METER Pressure Gauges.

THE ELECTRIC AUTO-LITE COMPANY

MOTO METER GAUGE & EQUIPMENT DIVISION

CHRYSLER BUILDING, NEW YORK, N. Y.

FACTORY LA CROSSE, WISCONSIN

ABOUT PEOPLE

C. L. Huston, Jr., has been named president of Lukenweld, Inc., Coatesville, Pa. He was formerly assistant to the president and member of the board of directors of Lukens Steel Co. Lukenweld, Inc., is engaged in the fabrication of welded structures used in marine and rail transportation and for industrial machinery.

» «

John G. Seiler has been elected vice-president of Tube Turns, Louisville, Ky., manufacturer of welding fittings and flanges. He will retain his duties as sales manager of this company.

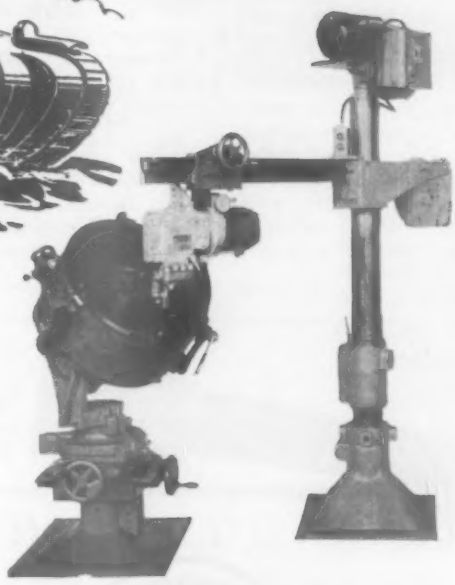
» «

G. A. MacGillivray, formerly connected with the Franklin Process Co., has been appointed west coast sales manager of Eutectic Welding Alloys Company.

» «

Hudson W. Reed, Jr., has been appointed director of personnel and safety at the American Welding & Manufacturing Co., Warren, O. He had been serving as safety director.

Quicker Welding . . With This Automatic Welding Machine Fixture



Reloading Is done During Welding Operation

THIS Acme dual fixture arrangement permits practically constant use of an automatic welding head, because one of the fixtures can be reloaded while the other is engaged in the welding operation.

The holding machine can be set to revolve at any angle from vertical to horizontal. (Illustration shows a wheel being welded at 45° angle.) Positioner arm swings from one fixture to the other, locking in proper position. Speed of rotating the work is adjustable, as desired.

ACME *Manufacturing Co.*
1642 HOWARD ST. • DETROIT, MICH.

WRITE
for information. Whatever your positioning problem on automatic welding, let us help you solve it. Write for complete information.

(Trade Mark Registered)

Doubly-Deoxidized Welding Alloys:

PENN BRONZE

TITAN BRONZE

TITAN MANGANESE BRONZE

Titan's Quality Control

ASSURES ABSOLUTE UNIFORMITY OF TITAN WELDING ALLOYS

Quality Control in manufacture of TITAN Welding Alloys begins with the selection of the finest available raw materials.

Only the purest raw materials are used: Electrolytic copper 99.96 plus in purity, and electrolytic zinc 99.99 plus. This assures the elimination of elements which if introduced would prove detrimental to quality and uniformity.

Maintenance of unvarying uniformity of mixtures and of casting temperatures, under strict laboratory control, further assures absolute uniformity of TITAN Alloys.

Descriptive literature sent upon request

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN WELDING RODS

H. E. Cable, formerly welding engineer, has been appointed representative in the Pittsburgh territory for The Lincoln Electric Co., Cleveland. He will assist W. R. Persons, Pittsburgh district manager.

» «

A number of changes among its sales personnel are announced by the Norton Co., Worcester, Mass. **Leroy K. Behr** has been appointed district manager in Philadelphia for the company's abrasive division, succeeding the late Allan Seymour. **John C. Ewer** takes over Mr. Behr's former territory in eastern Massachusetts and Maine. **C. Barnard Price, Jr.,** who has been field engineer for New England, succeeds Mr. Ewer as abrasive engineer for western Massachusetts, Rhode Island, Vermont and New Hampshire.

G. W. Thomson has been appointed abrasive engineer for the territory including the states of Oklahoma, Arkansas, western Tennessee and northern parts of Texas, Louisiana and Mississippi. **Henry L. LeMay** is taking over Mr. Thomson's former territory in northern Illinois.

J. P. Landers, who has been located in Norton's research laboratories and in the sales engineering department at Worcester, is now doing field engineering work in New York and New Jersey.

TYPE CB
TRIPLE-DUTY
HAMMER

CMD

WELDERS'
CHIPPING
HAMMERS

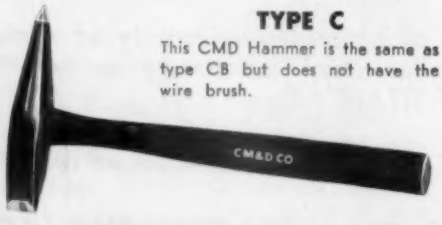
Stay Sharp Longer

Type CB has a convenient wire brush which can be easily replaced when worn. The head combines chisel and drift. Like all CMD Hammers, it is well balanced for easy use from any position—especially important for cleaning overhead welds. Weight, 16 oz.

The heads of CMD Welders' Chipping Hammers are made of exceptionally hard, specially tempered steel. Their cutting edges stay sharp longer and can take more regrindings when sharpening becomes necessary. CMD Hammers are also light, well balanced and easy to use.

Order from your Welding Supply House!
If they cannot supply you, order direct! Descriptive circular sent free upon request.

TYPE C
This CMD Hammer is the same as type CB but does not have the wire brush.



CHICAGO MANUFACTURING
AND DISTRIBUTING COMPANY
Dept. W., 1928 West 46th St., Chicago, Illinois

Ralph J. Cordiner has been appointed assistant to the president of the General Electric Co. Mr. Cordiner, who resigned in June as vice-chairman of WPB, was formerly president of Schick, Inc. and prior to that manager of the G-E appliance and merchandise department.

» «

Herbert E. Cragin, Lieutenant J. G., USNR and formerly foundry manager of the Taylor-Wharton Iron and Steel Co., High Bridge, N. J., has reported for duty with the Bureau of Ships of the Navy Department in Washington, D. C.

» «

Ralph C. Stuart, who has been with the Westinghouse Electric and Mfg. Co. for 25 years, was recently appointed manager of the company's Lamp Division at Bloomfield, N. J. He will have charge of all sales, manufacturing and engineering in the Division's five plants in New Jersey and West Virginia.

» «

K. R. Beardslee, for the past seven years general sales manager for Carboloy Co., Inc., Detroit, has been named vice-president in charge of sales.

» «

W. H. Cordes, advertising manager of the American Steel & Wire Co., Cleveland, has been selected to head the company's new sales research and development division. It will be the function of this division to carry on the study of postwar markets for existing products and to study and investigate the effect of the use of substitute materials and new applications of old materials.

» «

Paul Dietz has been appointed export sales manager for the general machinery div. of the Allis-Chalmers Mfg. Co., to take the position left vacant by the death of Harlow Bradley. Dietz comes to Allis-Chalmers from the export div. of the B. F. Goodrich Co., for which concern he served 15 years. Dietz was in Hong Kong when it fell to the Japanese but was able to return to the United States following negotiations between the U. S. state department and the Japanese government.

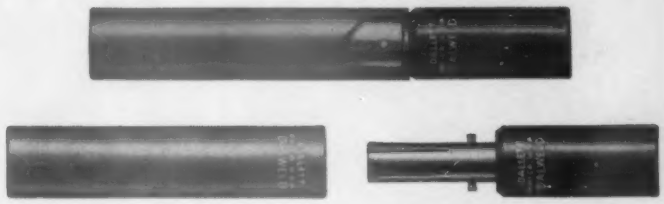
Died . . .

Charles F. Williams, a pioneer of the welding industry, died at Chicago on July 25, at the age of 82. He had retired on December 1, 1940, after 31 years of active service with the Davis-Bournonville Co. and the Air Reduction Sales Co., which acquired the Davis-Bournonville Co. March 17, 1922. "Charlie" (as he was known to his associates) was a service engineer for Airco at the time of his retirement.

» «

Allan Seymour, Philadelphia district manager for the abrasive division of Norton Co., Worcester, Mass., died on July 30. He had been with Norton for 25 years and in charge of the important Philadelphia branch since December, 1934.

"DALWELD"
DETACHABLE WELDING CABLE CONNECTOR *features:*



- Constructed for rough usage
- Large area contact
- Fully insulated
- Quick acting
- Quarter-twist connects or disconnects
- Cannot accidentally be pulled apart

The "Dalweld" saves time, power and cable; standard in many small shops, and the country's largest shipyards, aircraft factories, tank shops, etc. Write for descriptive literature.

THE DALLETT COMPANY

MASCHER AT LIPPINCOTT STREET — PHILADELPHIA 33, PENNSYLVANIA

PNEUMATIC "WELD-FLUX" SCALING HAMMERS ■ "DALBO" AIR HOSE COUPLINGS

"DALLETT" PNEUMATIC SAFETY RETAINER SHANK CHISELS

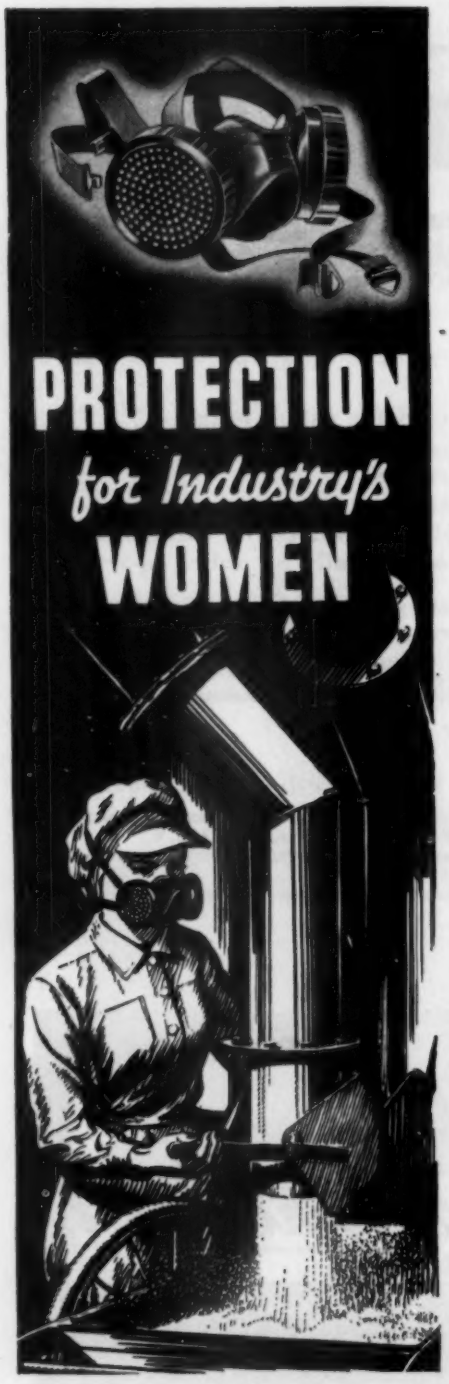
■ ■ *PNEUMATIC AND HAND CHISELS* ■ ■

● Everyone approves a bargain! And another way to interpret the attractive odds of 3 to 1 is—the installation of but *one* Sight Feed Acetylene Generator immediately brings you, Mr. Welder, *three* definite advantages:

1. **Assured** acetylene supply . . . independent of "bottlers"
2. **Visible** carbide supply . . . avoids large-job interruptions
3. **Economy** . . . saves YOU up to 75% in acetylene costs

So really you *don't gamble* when you select a Sight Feed Acetylene Generator. Your benefits are assured . . . conservatively stated, *one* will get you *three*.

THE SIGHT FEED GENERATOR COMPANY
Sales: Richmond, Ind. Factory: W. Alexandria, O.



As women willingly assume more hazardous jobs, they deserve—and are getting—every consideration for their health and safety.

Willson, leader among the makers of eye protective and respiratory devices, has engineered many special devices or adaptations for the ladies. Willson Respirator 570, for example, is particularly suited to women . . . protecting against metal fumes encountered in welding . . . toxic dusts . . . and acid mists. Your local Willson representative will gladly furnish additional information.

GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

DOUBLE WILLSON

PRODUCTS INCORPORATED

READING PA U S A

Helpful Literature Just Published

The following reviews are of recent publications of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

Atlas Circulars

Growing insistence by Army and Navy officials that the identities of weldors and welding inspectors be indicated by permanent marks in the steel has led to the development of a symbol hammer and various interchangeable inserts. In order not to add to the number of tools used by weldors, the symbol hammer (described in THE WELDING ENGINEER for December, 1942) is combined with a weld cleaning cone or chisel bit.

The above system of weld identification is fully described in a new four-page, letterhead-size circular just issued by **Atlas Welding Accessories Co.,** 307 Boulevard Bldg., Detroit 2. Some 180 standard outline designs of the 600 standard designs available are shown in this folder. By combining letters, numbers and symbols, it is possible to provide individual identification for crews as large as 15,000 weldors.

Also available from Atlas is a newly issued single-sheet leaflet titled "Weld-Cleaning Tools." This pictures and describes the various chipping hammers, brushes, tomahawks, electrode carrier cases, etc., which make up the Atlas line of weldors' accessories.

» «

Metallizing Catalog

A new 40-page catalog dealing with virtually all phases of the metallizing or metal-spraying process has just been published by the **Metallizing Co. of America,** 1330 W. Congress St., Chicago. The information contained in this book is classified according to industry, representing every major field in which metallizing is today being used. The equipment section of the book covers such Mogul products as the metallizing gun, the new electric bonder, and the "Link" (a high-frequency unit to simplify arc welding). A considerable section of the catalog is devoted to frequently asked questions pertaining to metallizing and their answers.

» «

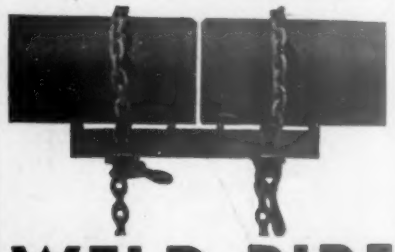
Fabricated Piping Booklet

A highly interesting booklet of 68 letterhead-size pages has just been issued to show some of the more important applications of fabricated piping. Power plants, invasion barges, oil refineries, pressure vessels, structural uses and may other applications are pictured. The second section of the book gives list prices for various kinds and sizes of fabricated piping components. Dept. A-12, **Flori Pipe Co.,** St. Louis, Mo.

» «

Safety Booklet

The efforts being made by the **National Safety Council, Inc.,** 20 North Wacker Drive, Chicago, to promote "off-the-job" safety are described in a 16-page, 6 by 9 in. booklet titled "270 Million Man-Days." The 270 million man-days referred to are a prediction of the time that will be lost to American industry this year because of accidents occurring to working men and women while they are on their own time. To help cut down the staggering number of off-job accidents now hampering the war effort, the Council has prepared safety posters, leaflets for employees, sound slide-films, cartoons, articles, etc. All of this material is listed and discussed in the explanatory booklet.



WELD PIPE
Faster . . . Easier . . . Truer
WITH
JEWEL PIPE CLAMPS

Weld more pipe in a day with Jewel Pipe Clamps. They keep the welder welding instead of waiting, for it only takes a minute to put them on and set the pipe in perfect alignment.

There is a Jewel Clamp to meet every layout condition — Jewel Pipe Clamp for straight-away work. Jewel Tube Turn Clamp. Jewel Welding Flange Clamp. Jewel Angle Clamp. All are rigidly constructed to resist strain, heat and abuse. All help cut erection costs.

Write Today for Circular Giving Complete Details

JEWEL Manufacturing Company
1841 University Ave.
ST. PAUL, MINNESOTA

Belden
WELDING CABLE

Rubber Covered ★ ★ Super-Flexible

SIZES AVAILABLE
#4 to #4/0
125 to 550 Amps.

PROMPT SHIPMENTS ! !

LOW PRICES!
(Large or Small Quantities)

Buy { By MAIL / TELEGRAPH / TELEPHONE

CONTINENTAL WELDING CABLE CO.
PHONE FRANKLIN 7100
333 NORTH MICHIGAN AVENUE CHICAGO, ILLINOIS

WELD-A-CAST Flux
The old brand is still the best

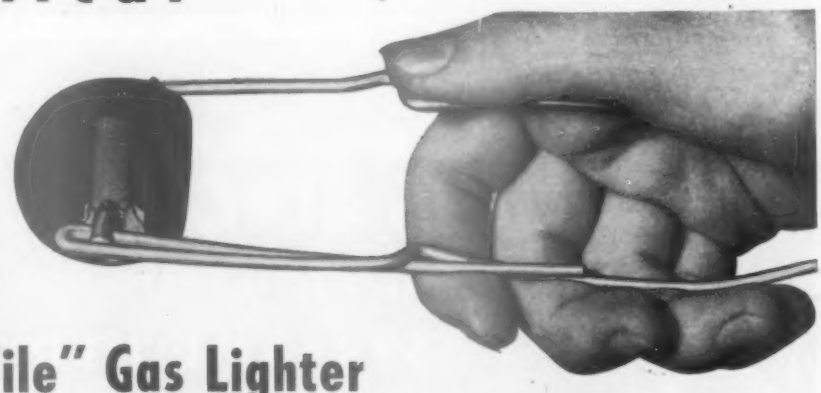
No. 1. For Welding with Cast Iron Rod.
No. 3. For Brazing and Bronze Welding.
No. 4. For Welding Cast Aluminum.

Ask Your Dealer—or write

CORTLAND WELDING COMPOUND CO.
Cortland, N. Y.

Most Economical

Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter.
A large file area is provided—approximately one square inch. **The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position,** permitting instant replacement. **Every part of the lighter is thoroughly tested.**



The Improved "Round File" Gas Lighter

Circulars and prices on request. SAFETY GAS LIGHTER Co. (Est. 1901) LYNN, MASSACHUSETTS

Vest Pocket Guide

A handy "Weldors' Vest Pocket Guide," 24 pages, 3½ by 6¼ in., has been prepared for free distribution to all weldors who will write to **The Hobard Brothers Co.**, Box EW-95, Troy, O. This booklet pictures and explains what is wrong with different types of faulty welds and shows how to correct such faults. There is also a "Trouble Check-Chart" on welding machine troubles, a "How to Find" section giving useful mathematical formulas, and explanations of the standard welding symbols appearing on blueprints.

» «

Electronic-Tube Primer

For those who just can't seem to keep straight the intricacies of electronic tubes, there is recommended the new G-E booklet, "How Electronic Tubes Work," 24 pages, 8 by 10½ in. Illustrated with 117 sketches and photographs, this book is a much-needed primer on how the electronic tube operates. It starts with such fundamentals as cathode, anode, heater, grid, terminals, envelope—gives the function of each part and the symbol used for it on drawings. The next section discusses gas-filled and high-vacuum tubes and explains how and why they differ. Finally, the eight basic members of the electronic-tube family—the kenotron, the pliotron, the phanotron, the ignitron, the glow tube, the phototube, the thyratron, the high-vacuum pentode —are introduced with a brief description of their respective functions. Of these, the ignitron and the thyratron are of the most importance to welding. The ignitron supplies the heavy alternating current needed for spot or seam welding of aluminum alloy, stainless steel, etc., and the thyratron times with split-second precision the heavy welding currents that are supplied by the ignitron.

This book, GEA-4116, is available free on request to Dept. 6-215, Publicity Div., **General Electric Co.**, Schenectady, N. Y.

» «

Farm Welding Circular

Though Amsco Bulletin 843-W is small in size (six pages, 3½ by 6¼ in.), its subject matter is of the utmost importance, for it tells farmers how they may increase the life of their plowshares and other equipment with "Farmface," a hard-facing welding rod. Made bare for torch and coated for arc welding, the rod has an iron base which causes it to weld readily to carbon steel, manganese steel and cast iron, the folder states. Besides plowshares, it may be applied to such other implement parts exposed to wear as: harrow teeth, discs, lister shares, cultivator spades, corn planter runners, potato diggers, beet puller points, corn husker teeth, ensilage cutter blades, thresher teeth, etc. **American Manganese Steel Div.**, American Brake Shoe Co., Chicago Heights, Ill.

Fire Fighting Data

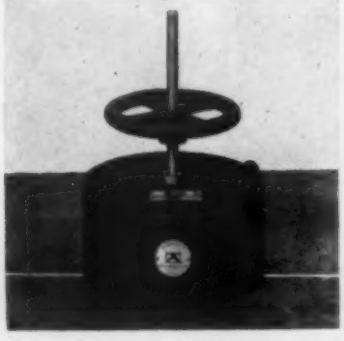
In anticipation of Fire Prevention Week, Oct. 3-9, two pamphlets have been published on the subjects of preventing and extinguishing fires. The first of these is a 16-page, 6 by 9 in. booklet, "Facts about Fire," issued by the **National Fire Protection Association**, 60 Batterymarch St., Boston. (Price 5c per copy.) This gives facts and figures on the economic losses caused by fires of various types—residential, industrial, farm, etc.—and suggests steps to take in order to prevent them.

The second booklet, "Fire and How to Fight It," is published by **Walter Kidde & Co., Inc.**, 140 Cedar St., New York City 6. This is a 36-page illustrated manual explaining the fundamentals of bringing different types of fires under control and giving brief directions for the use and maintenance of all the usual varieties of extinguishers — soda-acid, water, foam, vaporizing liquid, dry compound and carbon dioxide.

» «

Pipe Preheating Booklet

"Preheating, Welding, Normalizing by the Induction Method" is the title of a 40-page, letterhead-size catalog recently published by **Electric Arc, Inc.**, 152-162 Jelliff Ave., Newark. This gives detailed procedures for preheating piping with induction coils and describes and illustrates the equipment available.



ALIGNING BUTT END PLATES FOR TACK WELDING

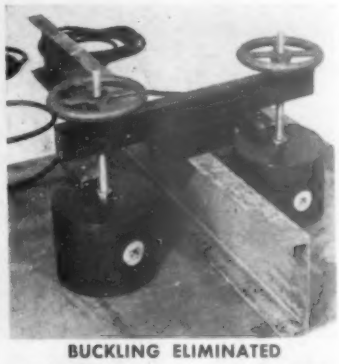
HERCULES ALIGNER is placed squarely on the seam and when energized instantly draws both plates flush against the perfect surface of the magnet thereby trueing up areas on both sides for tacking. Operation is quick, simple and foolproof. Magnetic pull is so tremendous that men can walk or work nearby without disturbing alignment. Units work in all positions (vertical, overhead, etc.).

Welders, Ship Fitters, Plate Fabricators!

FOR QUICK, PERFECT ALIGNMENT OF STEEL PLATES . . . FOR INCREASED PRODUCTION . . . FOR ELIMINATING WARPING . . .

HERCULES MAGNETIC ALIGNERS

Heavy butt end plates instantly aligned. Warped ¼" plates quickly positioned for welding to reinforced stiffener beams . . . pressures up to 4000 pounds! Units easily handled (weight 80 lbs.) No more welding on temporary clamps . . . No grinding, wedging . . . No using heavy weights.



BUCKLING ELIMINATED BY PRESSURING STIFFENER BEAM

Shipbuilding requires reinforced stiffener beams welded across each plate at stated intervals. Warped plates are quickly positioned for welding to the stiffener beam by placing the aligners as pictured. When current is on, ALIGNERS grip the plate and by turning the wheels 4000 lbs. pressure can be applied through the crossbar to the stiffener beam and plate, causing powerful adhesion and perfect unwarped fit.

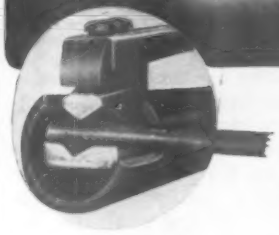
HERCULES ELECTRIC & MFG. CO. INC.

MANUFACTURERS OF THE PRECISION WELDER WITH THE

STREAMLINED ARC

2416 ATLANTIC AVENUE • BROOKLYN, N. Y.

SUPREME
FULLY INSULATED ELECTRODE HOLDER



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Air cooled completely — lightweight (1 Lb.) — balanced advantageously. Deoxidized copper throughout — high tension rod clamping with easy release pressure. Parts easily replaced.

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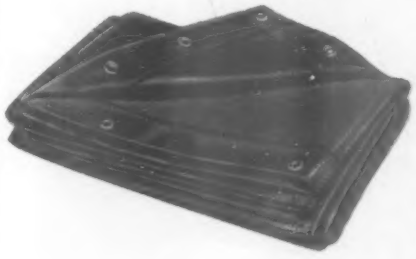

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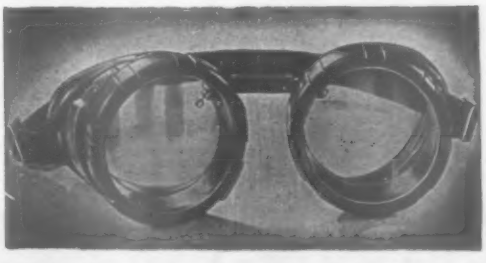
For Comfort and Safety use Rido' Ray Welders' Goggles

Light-weight, ample ventilation, perfect fit. Lenses can be changed instantly.



Rido' Ray Welders' Goggles possess a reputation for complete dependability.

PROMPT DELIVERY *Stocked by leading jobbers, or write direct*

HARRY BUEGELEISEN, Inc., Sole Mfrs. 181-183 Pacific Street, BROOKLYN, N. Y.

Galvanizing Repairs

A four-page letterhead-size circular, Bulletin No. 52, has been issued to discuss the uses of "Amco" galvanizing compound for the "on-the-spot" repair of galvanized surfaces damaged during fabrication assembly. Among its other applications, this product may be used for coating welded joints in order to renew galvanized surfaces which were destroyed by the welding heat. **American Solder & Flux Co.,** Dept. O., 2152 E. Norris St., Philadelphia 25.

» «

Steel Products Manual

Three newly revised sections of the "Steel Products Manual" have been issued as of June, 1943, by the **American Iron and Steel Institute,** 350 Fifth Ave., New York City. These are: Section 2, "Carbon Steel Semifinished Products"; Section 8, "Hot-Rolled Carbon-Steel Bars"; and Section 9, "Cold-Finished Steel Bars and Shafting." Section 2 was originally issued October, 1937, and Sections 8 and 9 in March, 1940. All three sections have undergone previous revisions.

» «

Incentive Guidebook

"Ideas that Work to Win!" is the title of a 24-page, 5 by 7 in. pamphlet just published by the Industrial Incentive Div., **Navy Department,** 2118 Massachusetts Ave., Washington, D. C. This publication lists various methods war plants can use to promote more and better production of necessary equipment for the men of our fleets. In the foreword, the objectives of the Navy's Industrial Incentive Division are outlined by its chief, Rear Admiral C. H. Woodward, USN (Ret.).

» «

Women for War Jobs

"Choosing Women for War Industry Jobs" is the title of a 12-page, 5 by 9 in. booklet just issued by the Women's Bureau of the U. S. Department of Labor. It covers such topics as the application blank, the interview, the interviewer, employments tests, etc. Copies may be obtained at five cents each from the **Superintendent of Documents,** Government Printing Office, Washington, D. C.

» «

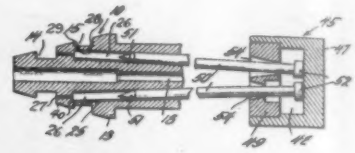
Burn Remedy Information

A folder describing "Cofen," a solution for the external treatment of burns, has been issued by **Lee-Wood, Inc.,** P.O. Box 212, South Norwalk, Conn. This product is used to relieve pain, to clean the wound, to avoid infection and for other first aid applications (see page 65, THE WELDING ENGINEER, August, 1943).

FROM THE PATENT OFFICE

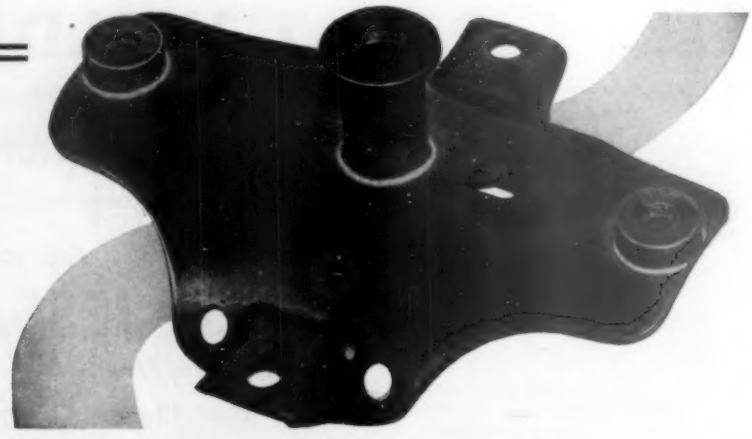
Torch Tip Assembly Jig

2,326,362. **Alexander F. Jenkins,** Baltimore. Filed July 31, 1940. Issued Aug. 10, 1943.



A fixture for assembling torch tips having a plurality of longitudinal bores; this fixture comprises a head and a plurality of projecting pins movably carried thereby. Lost motion connections between the head and pins are so constructed and arranged that the movement of the pins toward the work is limited to different prearranged distances. The common abuttment on the head provides a backstop for the pins. Thus the outer ends of the pins may be individually and successively introduced into the several bores of the torch and then forced equally therein by the application of pressure to the head.

THIS MOTOR BRACKET typifies the advantages of modern EASY-FLO Brazed Construction



This hanger bracket for a small electric motor used in airplanes is one of a long and growing list of parts formerly made from castings or forgings that have been redesigned for EASY-FLO brazed construction.

The reasons so many are changing to EASY-FLO brazed construction are—faster production—elimination of machine operations—reduction in weight—metal saving—and last but not least, low costs.

EASY-FLO IS THE KEY to the success of this low-temperature silver alloy brazed construction, because it makes joints that are as strong as solid metal—and makes them fast, reliably and at surprisingly low cost per joint.

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EASY-FLO BRAZING IS HERE TO STAY. *The exceptional speed, reliability and economy EASY-FLO brings to the joining of both ferrous and nonferrous metals account for the phenomenal spread in its use on war production and assure an increasing use in peacetime maufacturing. Get the facts in Bulletin No. 12-A. Plan to use it in your post-war production.*

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Use Fluxine No. 18 for gas welding stainless steel manifolds, muffler tubes, exhaust pipes and other parts for aircraft.

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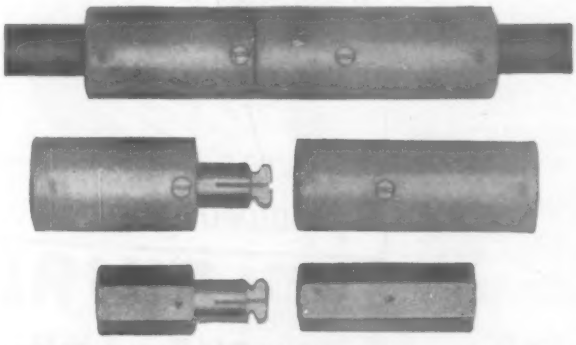
Type SOL-CON



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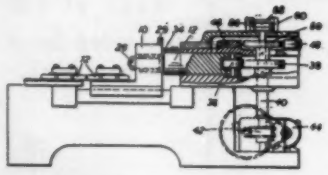
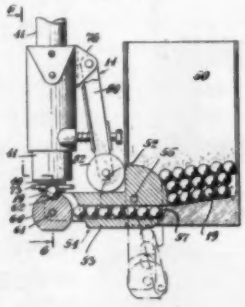


Flash Welding Machine

2,324,944. **William Hammond Millwood,** Inverness, Scotland. Filed Dec. 15, 1941. Issued July 20, 1943.

An automatic resistance flash welding machine comprising a moving head, feeding means, and means for stopping and reversing the forward feeding movement. The moving head is adapted to carry one of two work pieces which are alternately brought together and separated during an initial preheating period. Between the head and the feed means, there is interposed a resilient mechanism adapted to effect on compression the stoppage and reversal of the forward movement as a consequence of the mechanical resistance created by the meeting of the two work pieces.

» «

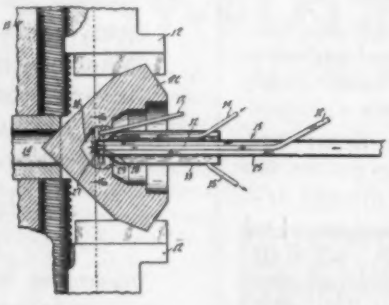


Projection Welder

2,325,507. **Howard P. Guirl,** East Chicago, Ind., and **Fred G. Troppman,** Lansing, Ill., assigned to **The Superheater Co.,** New York City. Filed March 31, 1942. Issued July 27, 1943.

A welding apparatus having a work support and an electrode which may be moved toward the support to engage a metallic element against a metallic work piece. When contact is completed, an electric current passes through element and work piece to weld them together.

» «



Hard-Facing Application

2,326,403. **Raymond C. Snyder,** Franklin, Pa., assigned to **Chicago Pneumatic Tool Co.,** New York City. Filed Oct. 11, 1941. Issued Aug. 10, 1943.

A method of hard-facing a bearing surface on the internal wall of a roller cutter. The cutter and a heating torch are supported for relative rotational movement, the burner end of the torch extending into the cutter bore while the cutter rotates. Flame jets are discharged through radial outlets to heat the wall of the bore along an annular path and melt a rod composed of hard-facing particles contained within a suitable binding agent. When the binding agent melts, the hard-facing particles are deposited in the wall of the bore, in the area of the annular path.

This patent also covers a torch having a tubular end portion, radial discharge ports, and a longitudinal venting passage connected at either end to the atmosphere. One end of the latter passage opens at a point rearward of the radial ports and the other at a point in advance of the radial ports.

» «

Weld Cooling Method

2,325,113. **James R. Craig,** Kenmore, N. Y., assigned to **The Linde Air Products Co.** Filed Jan. 23, 1940. Issued July 27, 1943.

A method of cooling a newly welded metal joint between metal members by directing one or more streams of cooling fluid against one of the members. Streams are directed adjacent to, but not directly against, the joint, which is temporarily covered to exclude it from direct contact with the cooling fluid.

There's the order — provided you use . . .

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Welders appreciation of their pliability and durability make repeat sales certain. Available in large spread whole kips and side splits in all weights for men and women welders' gloves and garments.

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★ When attached to arc welders, AC or DC, the Missing Link starts the arc *before* the electrode touches the work. No more "scratching" the work to get going. No sticking of electrode to the work. Permits experienced operators to perform with highest efficiency. Reduces Fatigue. Even untrained beginners can pitch right in and do a good job of welding with the aid of the Missing Link.

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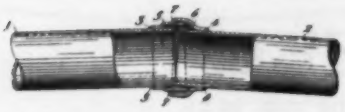
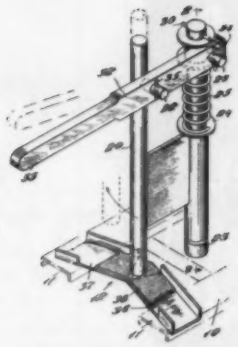


Welded Pipe Joint

2,324,928. **Harold O. Hill,** Bethlehem, Pa., assigned to **Bethlehem Steel Co.** Filed April 26, 1941. Issued July 20, 1943.

A joint for connecting metallic pipe having a heat-destructible inner coating. While the ends of the coated pipe sections to be joined are in abutting relation, two bell-shaped sleeves of different sizes are secured to project forwardly beyond the abutting ends. The smaller sleeve is inserted within the larger, and a welded connection is made between the outer end of the larger sleeve and the outer side of the smaller sleeve. The sleeves are so arranged and adapted as to provide a heat-insulating air space beneath the welded connection.



Welding Clamp

2,323,450. **Gericho Brosco,** Warwick, R. I., assigned one third to **Constance B. Sargent,** Boston, and one sixth to **Fred Brosco,** Johnston, R. I. Filed April 16, 1942. Issued July 6, 1943.

A work clamp comprising a rigid post and a jaw carried on an arm. The arm-mounting means is urged by a spring in the direction of the longitudinal axis of the post. A pivot is swivelly mounted on the post, and a lever is swivelly mounted on the pivot for acting on the jaw member and moving it against the action of the spring.

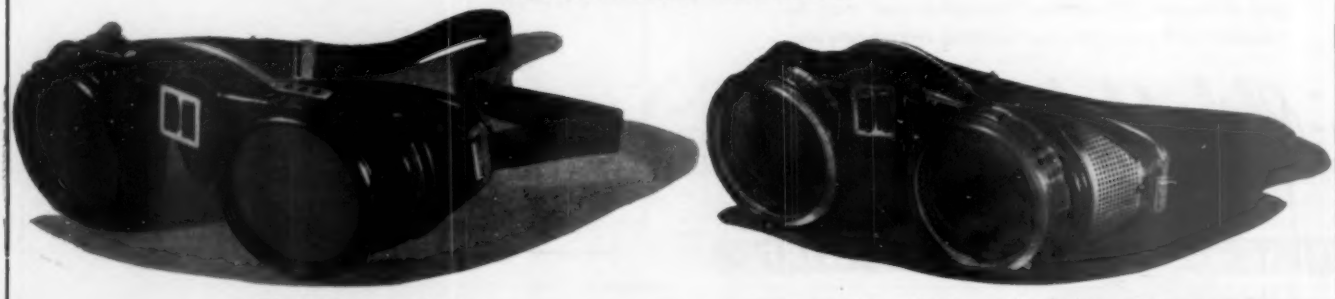
» «

Magnesium Filler Rod

2,325,014. **James J. Prendergast** and **Carl F. Gladen,** Bay City, Mich., and **Ronald A. Jones,** Midland, Mich., assigned to **The Dow Chemical Co.,** Midland. Filed March 25, 1942. Issued July 20, 1943.

A composition for coating rods used in the arc welding of magnesium and magnesium-base alloys. The coating is composed of a mixture of alkali metal halides; namely, the elements potassium, sodium and lithium in chemical combination with chlorine and fluorine.

Metro's New Coveralls



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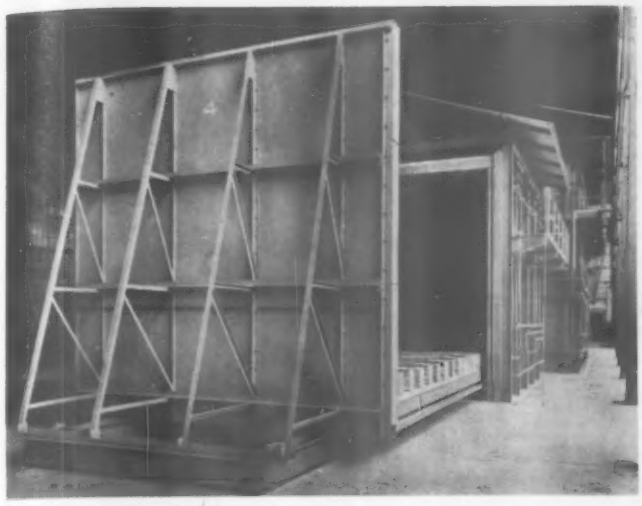

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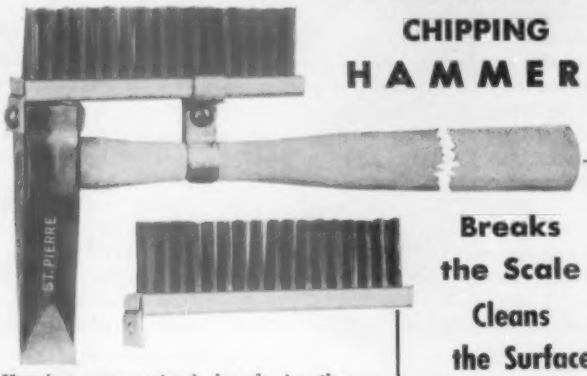

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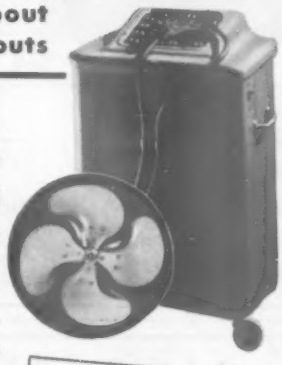

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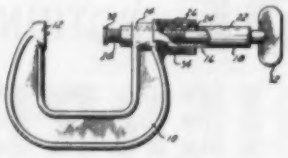
LYON-Raymond Corporation
MATERIAL HANDLING EQUIPMENT
266 Madison St. Greene, N. Y.

Quick Acting Clamp

2,322,471. **Robert D. Robertson,** Santa Monica, Calif. Filed Nov. 4, 1940. Issued June 22, 1943.



A C-clamp having a body member, a movable jaw, a stationary jaw, a bearing opposite the stationary jaw and an internally threaded cylinder rotatably carried by the bearing. Cylinder has a longitudinally extending groove with pockets along one side and inclined forwardly from the groove. A detent, carried by the bearing, is adapted to slide in the cylinder groove in one position of the cylinder and to engage one of the pockets when the cylinder has been rotated to another position. A sleeve slidable over the bearing and its opening holds the detent therein. A bowed and threaded shaft in the cylinder carries the movable jaw at its inner end. The bowing of this shaft affords a slight binding relation between the shaft and cylinder so that the rotation of the shaft in one direction will turn the cylinder to position the detent in one of its pockets and rotation of the shaft in the opposite direction will position the detent in the groove.

» «

Seam Welding Method

2,323,349. **Harold T. Odquist,** Yonkers, N. Y., assigned to **American Can Co.,** New York City. Filed July 1, 1939. Issued July 6, 1943.

A method of resistance welding a composite metallic seam having sections which require different welding treatments. A current of variable magnitude is passed into the seam, imparting to it an uninterrupted but varying heat input in a continuous welding cycle. The variations of heat input are arranged in a pattern corresponding to the different welding treatments required for the seam sections, and the beginning and ending of the welding cycle are timed in synchronism with the relative movement between the seam and the electrode.

» «

Multiple Spot Welder

2,323,696. **William A. Weightman,** Philadelphia, Pa., assigned to **Edward G. Budd Mfg. Co.,** Philadelphia. Filed Dec. 7, 1940. Issued July 6, 1943.

A multiple spot welding apparatus comprising a base and an overhanging support for a plurality of depending welding guns having welding electrodes positioned at an angle to each other and to the direction of movement of the work. The work support is raised from a work loading position to an elevated welding position. Welding electrodes are so positioned that horizontal welds may be made on the work.

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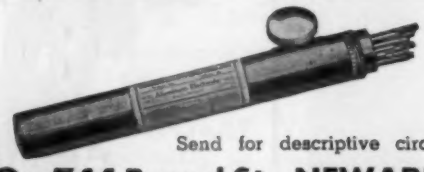

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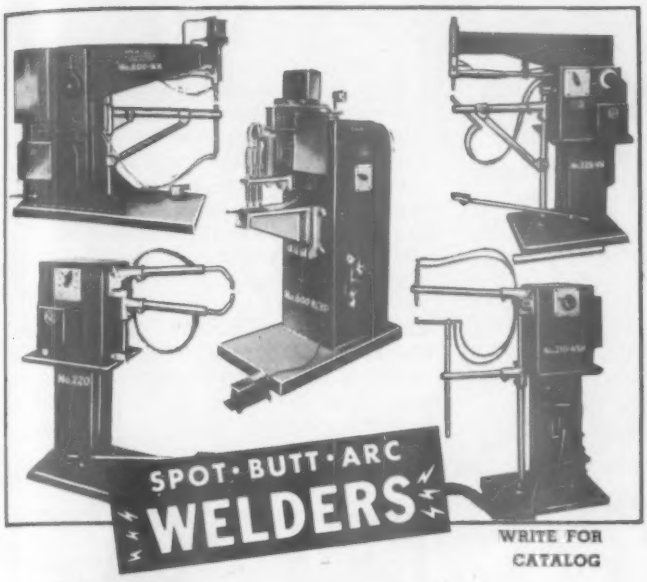

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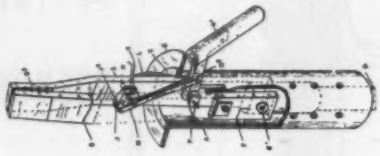
Spot Welding Electrode

2,322,101. **Joseph Winlock** and **John J. MacKinney,** Philadelphia, assigned to **Edward G. Budd Mfg. Co.,** Philadelphia. Filed Feb. 3, 1942. Issued June 15, 1943.

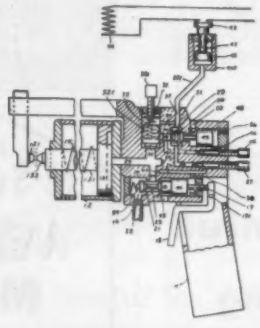
A welding electrode having a spherical end tip, the radius of which is between 1 and 2½ in. The length of the radius is three to eight times the diameter of the tip.



Electrode Holder

2,324,320. **Morton A. Pelton,** Detroit. Filed Nov. 29, 1941. Issued July 13, 1943.

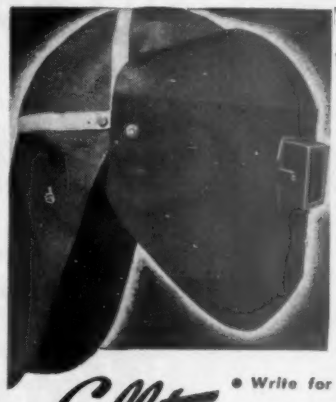
This electrode holder comprises a laterally apertured tubular sleeve of nonconducting material, means for effecting the anchorage therein of an inserted cable end, a manually operated trigger pivotally anchored at one end within the sleeve and a pair of electrode-holding jaws located in substantially parallel relation partly within and partly externally of the sleeve. The jaws are pivotally and electrically connected at their inner ends with the cable anchorage means. A spring urges the free ends of the jaws into contact with one another at their outer ends, while a tapered angle lever, positioned between the jaws, is adapted to force them away from one another for the insertion of an electrode.



Welding Gun

2,322,611. **Bruno E. Winkler,** Detroit. Filed April 27, 1940. Issued June 22, 1942.

An air-operated timer for actuating main and secondary pistons for different time periods of predetermined length. Pistons are normally held in retracted position within their cylinders by spring pressure. The body member has an air accumulating chamber which carries a spring-pressed delay valve and a manually operated air inlet valve that is normally closed by spring pressure. When opened, the latter valve connects a source of compressed air with the accumulating chamber, from which runs a connection to the main piston, to the delay valve and to a bypass arranged to bleed air from the accumulating chamber until the delay valve is opened. The body member also has a secondary air passage, normally closed by the delay valve, leading from the air accumulating chamber to the secondary piston; the delay valve is so arranged that its opening simultaneously stops the bleeding of air from the accumulating chamber and admits air to the secondary air passage to move the secondary piston. The secondary air passage may be closed behind the delay valve after a predetermined time, permitting air to be exhausted from the secondary cylinder. Later closing of the air inlet valve permits the exhausting of air from the accumulating chamber and connected passages and allows the return of the main piston and delay valve to their retracted positions.



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